VectorStar®

High Performance, Broadband Network Analysis Solutions

MS464xB Series Microwave Vector Network Analyzers

Introduction

This document provides detailed specifications for the MS4640B series microwave Vector Network Analyzers (VNAs) listed below, including all related options, and accessories.

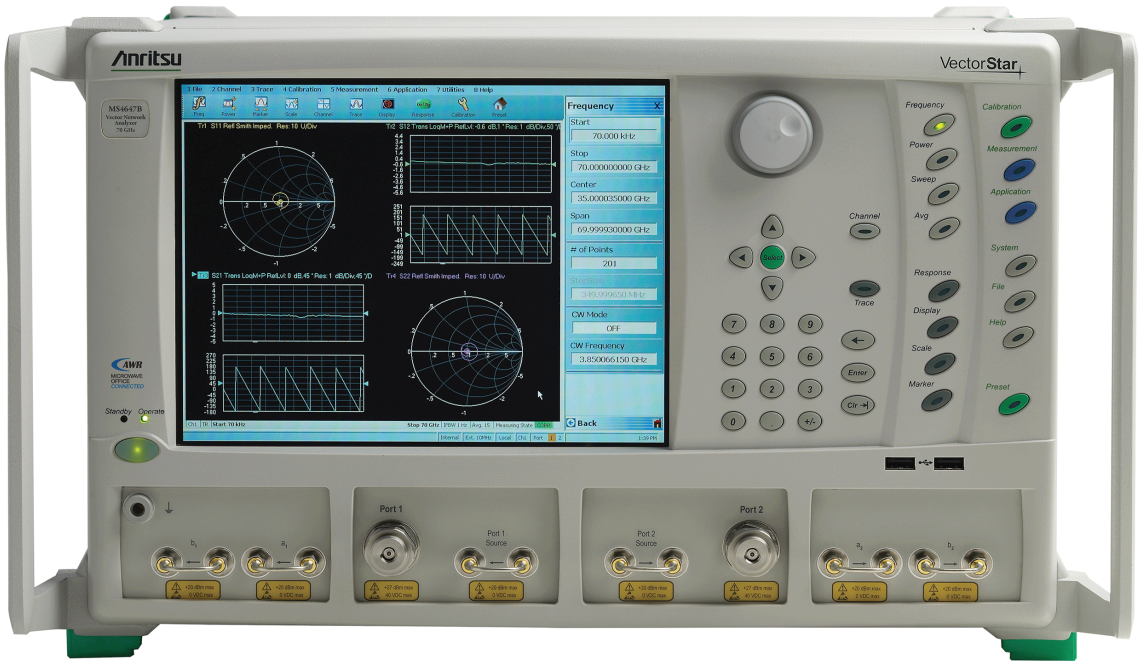
Instrument Models and Operating Frequencies

- MS4642B – 10 MHz to 20 GHz
- MS4644B – 10 MHz to 40 GHz
- MS4645B – 10 MHz to 50 GHz
- MS4647B – 10 MHz to 70 GHz
- Extended Operating Frequency Details Inside

Principal Options

- MS4640B-002 – Time Domain
- MS4640B-007 – Receiver Offset
- MS464xB-031 – Dual Source Architecture
- MS464xB-032 – Internal RF Combiner
- MS4640B-035 – IF Digitizer
- MS4640B-041 – Noise Figure
- MS4640B-042 – PulseView™
- MS4640B-043 – DifferentialView™
- MS464xB-044 – IMDView™
- MS4640B-070 – 70 kHz Low-End Frequency Extension

A detailed color brochure available on the Anritsu web site (www.anritsu.com/vectorstar) provides descriptions and examples of the VectorStar family's features and benefits. The web site also provides detailed information on 110 /125/145 GHz Broadband Coaxial, Banded Waveguide, and Multiport solutions based on the MS4640B VNA.



VectorStar MS4640B Series VNA

Description **Page**

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 90 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Over the 25 °C ± 5 °C temperature range.
Error-Corrected Specifications	For error-corrected specifications, over 23 °C ± 3 °C, with < 1 °C variation from calibration temperature. For error-corrected specifications are warranted and include guard-bands, unless otherwise stated.
Frequency Bands in Tables	When a frequency is listed in two rows of the same table, the specification for the common frequency is taken from the lower frequency band, except when the band edge is less than 5 GHz.
User Cables	Specifications do not include effects of any user cables attached to the instrument.
Discrete Spurious Responses	Specifications may exclude discrete spurious responses.
Internal Reference Signal	All specifications apply with internal 10 MHz Crystal Oscillator Reference Signal.
Interpolation Mode	All specifications are with Interpolation Mode Off.
Standard	Refers to instruments without Options 051, 061, or 062.
Typical Performance	Typical performance indicates the measured performance of an average unit. It does not include guard-bands and is not covered by the product warranty. Typical specifications are shown in parenthesis, such as (-102 dB), or noted as Typical.
Characteristic Performance	Characteristic performance indicates a performance designed-in and verified during the design phase. It does include guard-bands and is not covered by the product warranty.
Below 300 kHz	All uncertainties below 300 kHz are typical.
Recommended Calibration Cycle	12 months (Residual specifications also require calibration kit calibration cycle adherence.)
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com
Nominal	Nominal performance indicates a performance designed in and observed during the design phase. It does not include guard bands, is not production tested, and is not covered by the product warranty.

System Dynamic Range

System dynamic range is calculated as the difference between the maximum rated source power and the specified noise floor at the specified reference plane. Option 031 System Dynamic Range is listed in alternating tables. Note that Option 032 System Dynamic Range differs by the delta in max power.

MS4642B 20 GHz Model, System Dynamic Range (dB)

	at Ports 1 or 2			at b_1 or b_2	
Frequency Range	**Standard**	**Option 051**	**Option 061[a] or 062**	**Option 051**	**Option 061[a] or 062**
0.07 to 0.3 MHz	85	83	81	114	112
> 0.3 to 2 MHz	102	100	98	126	124
> 2 to 10 MHz	115	113	111	134	132
> 0.01 to 2.5 GHz	122	119	114	140	135
> 2.5 to 20 GHz	123	119	115	134	130
With Option 031					
0.07 to 0.3 MHz	87	85	83	116	114
> 0.3 to 2 MHz	104	102	100	128	126
> 2 to 10 MHz	117	115	113	136	134
> 0.01 to 2.5 GHz	124	121	116	142	137
> 2.5 to 20 GHz	124	120	116	135	131

MS4644B 40 GHz Model, System Dynamic Range (dB)

	at Ports 1 or 2			at b_1 or b_2	
Frequency Range	**Standard**	**Option 051**	**Option 061[a] or 062**	**Option 051**	**Option 061[a] or 062**
0.07 to 0.3 MHz	85	83	81	114	112
> 0.3 to 2 MHz	102	100	98	126	124
> 2 to 10 MHz	115	113	111	134	132
> 0.01 to 2.5 GHz	122	119	114	140	135
> 2.5 to 40 GHz	119	115	110	130	125
With Option 031					
0.07 to 0.3 MHz	87	85	83	116	114
> 0.3 to 2 MHz	104	102	100	128	126
> 2 to 10 MHz	117	115	113	136	134
> 0.01 to 2.5 GHz	129	121	116	142	137
> 2.5 to 40 GHz	122	118	113	133	128

MS4645B & MS4647B 50 & 70 GHz Models, System Dynamic Range (dB)

	at Ports 1 or 2			at b_1 or b_2	
Frequency Range	**Standard**	**Option 051**	**Option 061[a] or 062**	**Option 051**	**Option 061[a] or 062**
0.07 to 0.3 MHz	85	83	81	114	112
> 0.3 to 2 MHz	102	100	98	126	124
> 2 to 10 MHz	115	113	111	134	132
> 0.01 to 2.5 GHz	122	119	114	140	135
> 2.5 to 5 GHz	116	112	106	127	121
> 5 to 20 GHz	115	111	105	126	120
> 20 to 38 GHz	116	111	105	126	120
> 38 to 50 GHz	115	109	104	124	119
> 50 to 65 GHz	110	104	99	119	115
> 65 to 67 GHz	108	103	95	117	111
> 67 to 70 GHz	107	100	90	110	106
With Option 031					
0.07 to 0.3 MHz	87	85	83	116	114
> 0.3 to 2 MHz	104	102	100	128	126
> 2 to 10 MHz	117	115	113	136	134
> 0.01 to 2.5 GHz	124	121	116	142	137
> 2.5 to 5 GHz	118	114	108	129	123
> 5 to 20 GHz	118	114	108	129	123
> 20 to 38 GHz	118	113	107	128	122
> 38 to 50 GHz	117	111	106	126	121
> 50 to 65 GHz	117	111	106	126	122
> 65 to 67 GHz	116	111	103	125	119
> 67 to 70 GHz	114	107	97	120	113

a. The Option 061 Dynamic Range reported in this column applies for S_{21} measurements. For S_{12} Dynamic Range, use the figures from the Option 051 column.

Receiver Dynamic Range

Calculated as the difference between the maximum receiver input level for 0.1 dB compression and the specified noise floor at the specified reference plane. Characteristic Performance.

All Models, Receiver Dynamic Range (dB)

	at Ports 1 or 2			at b_1 or b_2	
Frequency Range	**Standard**	**Option 051**	**Option 061[a] or 062**	**Option 051**	**Option 061[a] or 062**
0.07 to 0.3 MHz	80	79	78	90	89
> 0.3 to 2 MHz	102	102	102	107	107
> 2 to 10 MHz	115	115	115	115	115
> 0.01 to 2.5 GHz	120	119	116	119	116
> 2.5 to 5 GHz	120	118	115	117	114
> 5 to 20 GHz	120	118	115	118	115
> 20 to 40 GHz[b]	120	118	115	118	116
> 38 to 50 GHz	120	118	117	117	117
> 50 to 65 GHz	117	115	115	113	114
> 65 to 67 GHz	115	113	111	110	109
> 67 to 70 GHz	113	110	109	107	108

a. The Option 061 Dynamic Range reported in this column applies for S_{21} measurements. For S_{12} Dynamic Range, use the figures from the Option 051 column.

b. 20 to 38 GHz for MS4645B or MS4647B.

Receiver Compression

Port power level beyond which the response may be compressed more than 0.1 dB relative to the normalization level. 10 Hz IF bandwidth used to remove any high level noise effects. Match not included. Performance is characteristic.

All Models, Compression Levels (dBm)

	0.1 dB Compression Levels in dBm relative to the Normalization Level[a]					
	at Ports 1 or 2			at a_x loops	at b_x loops	
Frequency Range	**Standard**	**Option 051**	**Option 061[bc] or 062**	**Option 051, 061, or 062**	**Option 051**	**Option 061 or 062**
0.07 to 0.3 MHz	+5	+5	+5	–15	–15	–15
> 0.3 to 10 MHz	+10	+11	+12	–10	–10	–9
> 0.01 to 2.5 GHz	+10	+11	+12	–10	–10	–9
> 2.5 to 5 GHz	+10	+11	+12	–5	–5	–4
> 5 to 20 GHz	+10	+11	+12	–4	–4	–3
> 20 to 40 GHz[d]	+10	+11	+12	–4	–4	–2
> 38 to 50 GHz	+10	+12	+14	–4	–4	–1
> 50 to 65 GHz	+10	+12	+14	–5	–5	–2
> 65 to 67 GHz	+10	+13	+15	–5	–5	–2
> 67 to 70 GHz	+10	+13	+15	–5	–5	–1

a. 0.3 dB for < 0.3 MHz.

b. The Option 061 compression level reported in this column applies to Port 2 or b_2. For Port 1 or b_1 compression level, use the figures from the appropriate Port X or b_x Option 051 column.

c. In pulse modes (Option 042), compression is measured with 1 kHz IF bandwidth and the compression level is 0.3 dB below 1 GHz.

d. 20 to 38 GHz for MS4645B and MS4647B.

During intermodulation measurements it is useful to know the linearity of the receiver. In addition to considering the receiver compression point, it is helpful to understand the third order Intercept Point (IP3) of the receiver. IP3 can therefore be used as a figure of merit to describe the range and quality of IMD measurements. The nominal IP3 performance provided is valid with or without the option 032 combiner and represents the receiver performance at the input of the test port. Minimal degradation of IP3 at different tone spacings. For the approximate IP3 of the receiver at the sampler input, deduct ~13 dB from the numbers below. The spec values below were derived by using -10 dBm/tone power incident at the receive port, a tone spacing of 3 MHz (reducing to frequency/10 for frequencies under 30 MHz) and an IF bandwidth of no more than 10 Hz.

All Models, Third Order Intercept Point (IP3, dBm)

Frequency Range	At Port 2 (Nominal)
0.07 MHz to 0.3 MHz	+20
0.3 MHz to 1.0 GHz	+25
> 1.0 GHz to 20/40/50/70 GHz (max frequency of the models)	+35

High Level Noise

Measured at 1 kHz IF bandwidth, at default power, with either full reflects or through transmission. RMS. Characteristic performance on MS4645B and MS4647B with either Option 051, 061, or 062. High level noise magnitude may be degraded to 20 mdB RMS (typical) at particular frequencies due to receiver residuals.

Frequency (GHz)	Magnitude (dB)	Phase (degree)
70 kHz to 500 kHz	< 0.04	< 0.4
> 500 kHz to 2.5	< 0.0045	< 0.05
> 2.5 to 5	< 0.0045	< 0.05
> 5 to 20	< 0.0045	< 0.05
> 20 to 40	< 0.006	< 0.06
> 40 to 67	< 0.006	< 0.08
> 67 to 70	< 0.008 (< 0.006)	< 0.08

Noise Floor

Measured at 10 Hz IF Bandwidth with no averaging, and at –10 dBm port power. RMS, no leakage correction applied. Measurement made with a through line connection, with its effects compensated for. Performance at a_x and b_x loops is characteristic.

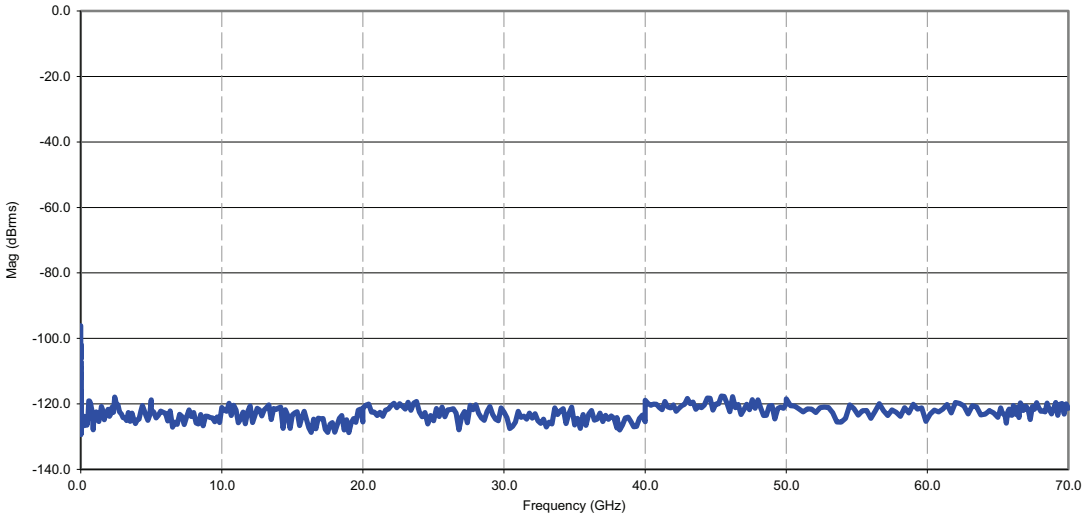
All Models, Noise Floor (dBm)

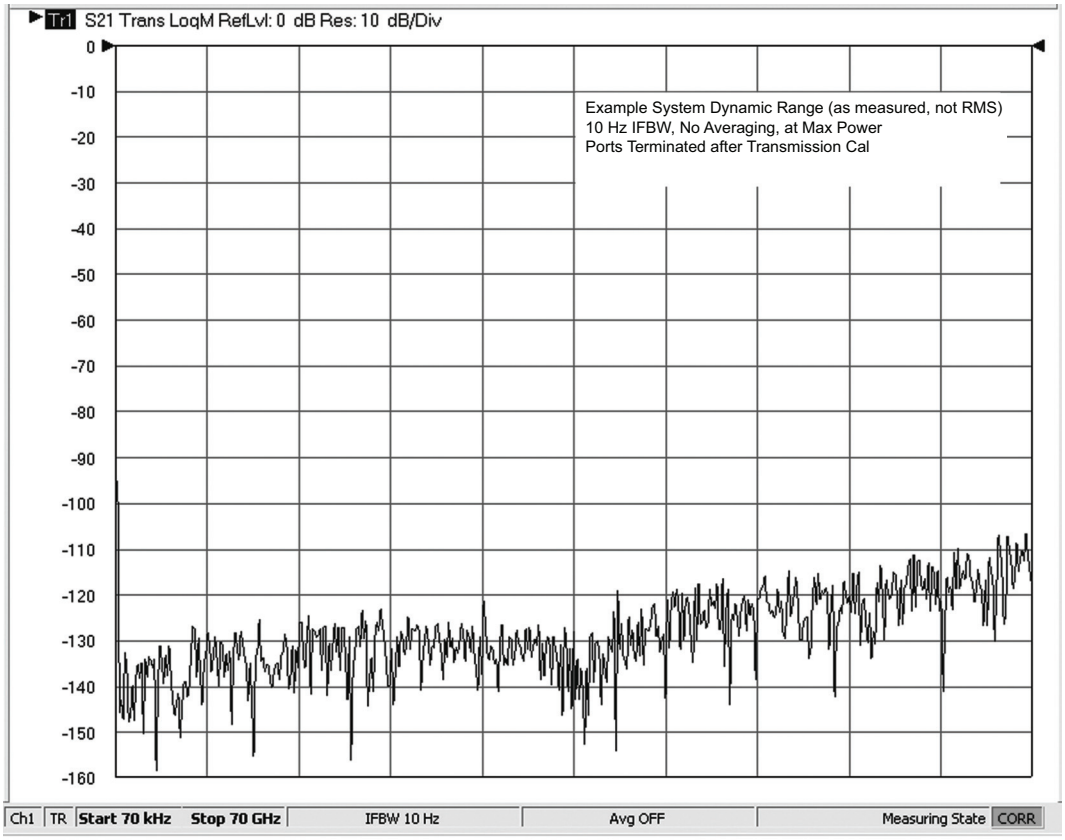
	At Ports 1 or 2			At a_x Loops	At b_x Loops	
Frequency Range	Standard	Option 051	Option 061[a] or 062	Option 051, 061, or 062	Option 051	Option 061[a] or 062
0.07 to 0.3 MHz	–75	–74	–73	–105	–105	–104
> 0.3 to 2 MHz	–92	–91	–90	–117	–117	–116
> 2 to 10 MHz	–105	–104	–103	–125	–125	–124
> 0.01 to 2.5 GHz	–110	–108	–104	–129	–129	–125
> 2.5 to 40 GHz[b]	–110	–107	–103	–121	–122	–118
> 38 to 50 GHz	–110	–106	–103	–121	–121	–118
> 50 to 65 GHz	–110	–106	–103	–121	–121	–119
> 65 to 67 GHz	–110	–106	–100	–120	–120	–116
> 67 to 70 GHz	–110	–106	–100	–115	–119	–116

a. The Option 061 noise floor reported in this column applies to Port 2 or b_2. For Port 1 or b_1 noise floor, use the figures from the appropriate $Port_x$ or b_x Option 051 column.

b. 2.5 to 38 GHz for MS4645B and MS4647B.

MS4647B Example Noise Floor (standard configuration)





Example System Dynamic Range

Power Range

Maximum Rated Power to minimum level. The difference reflects the ALC range for standard models or with Option 051, and the ALC + Attenuator Range for models with Options 061 or 062. Maximum Rated Power is typical from 2.4 - 2.7 GHz.

MS4642B, 20 GHz Model, Power Range (dBm)

Frequency	Standard	Option 051	Option 061[a] or 062
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –95
> 0.01 to 2.5 GHz	+12 to –25	+11 to –25	+10 to –95
> 2.5 to 20 GHz	+13 to –20	+12 to –20	+11 to –90
With Option 031			
70 kHz to 0.01 GHz	+12 to –25	+11 to –25	+10 to –95
> 0.01 to 2.5 GHz	+14 to –25	+13 to –25	+12 to –95
> 2.5 to 20 GHz	+14 to –20	+13 to –20	+12 to –90

a. The Option 061 power range reported in this column applies to Port 1. For Port 2, use the figures from the Option 051 column.

MS4644B, 40 GHz Model, Power Range (dBm)

Frequency	Standard	Option 051	Option 061[a] or 062
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –95
> 0.01 to 2.5 GHz	+12 to –25	+11 to –25	+10 to –95
> 2.5 to 20 GHz	+9 to –20	+8 to –20	+7 to –90
> 20 to 40 GHz	+9 to –25	+8 to –25	+7 to –95
With Option 031			
70 kHz to 0.01 GHz	+12 to –25	+11 to –25	+10 to –95
> 0.01 to 2.5 GHz	+14 to –25	+13 to –25	+12 to –95
> 2.5 to 20 GHz	+12 to –20	+11 to –20	+10 to –90
> 20 to 40 GHz	+12 to –25	+11 to –25	+10 to –95

a. The Option 061 power range reported in this column applies to Port 1. For Port 2, use the figures from the Option 051 column.

MS4645B & MS4647B, 50 & 70 GHz Models, Power Range (dBm)

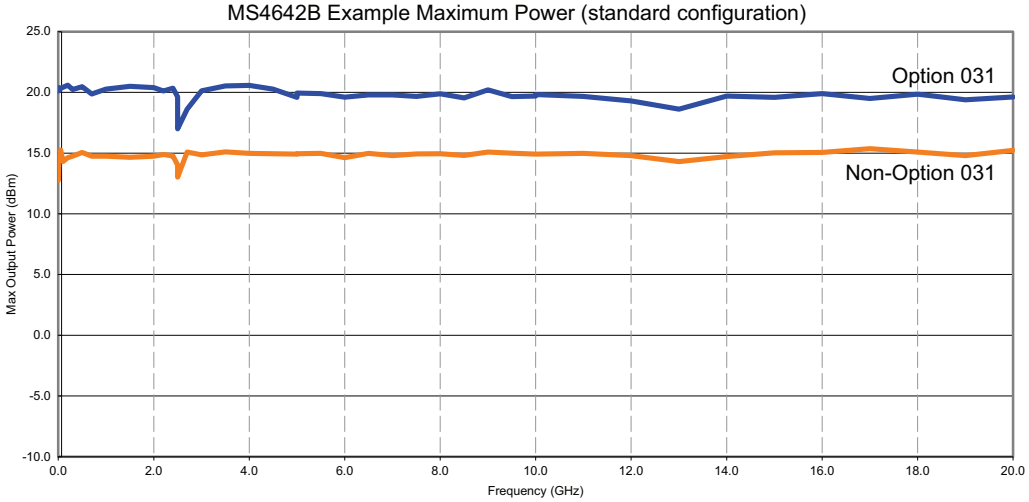
Frequency	Standard	Option 051	Option 061[a] or 062
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –85
> 0.01 to 2.5 GHz	+12 to –25	+11 to –25	+10 to –85
> 2.5 to 5 GHz	+6 to –20	+5 to –20	+3 to –80
> 5 to 20 GHz	+5 to –20	+4 to –20	+2 to –80
> 20 to 38 GHz	+6 to –25	+4 to –25	+2 to –85
> 38 to 50 GHz[b]	+5 to –25	+3 to –25	+1 to –85
> 50 to 65 GHz	0 to –25	–2 to –25	–4 to –85
> 65 to 67 GHz	–2 to –25	–3 to –25	–5 to –85
> 67 to 70 GHz	–3 to –25	–6 to –25	–10 to –85
With Option 031[c]			
70 kHz to 0.01 GHz	+12 to –25	+11 to –25	+10 to –85
> 0.01 to 2.5 GHz	+14 to –25	+13 to –25	+12 to –85
> 2.5 to 5 GHz	+8 to –20	+7 to –20	+5 to –80
> 5 to 20 GHz	+8 to –20	+7 to –20	+5 to –80
> 20 to 38 GHz	+8 to –25	+6 to –25	+4 to –85
> 38 to 50 GHz	+7 to –25	+5 to –25	+3 to –85
> 50 to 65 GHz	+7 to –25	+5 to –25	+3 to –85
> 65 to 67 GHz	+6 to –25	+4 to –25	+2 to –85
> 67 to 70 GHz	+4 to –25	+1 to –25	–3 to –85

a. The Option 061 power range reported in this column applies to Port 1. For Port 2, use the figures from the Option 051 column.

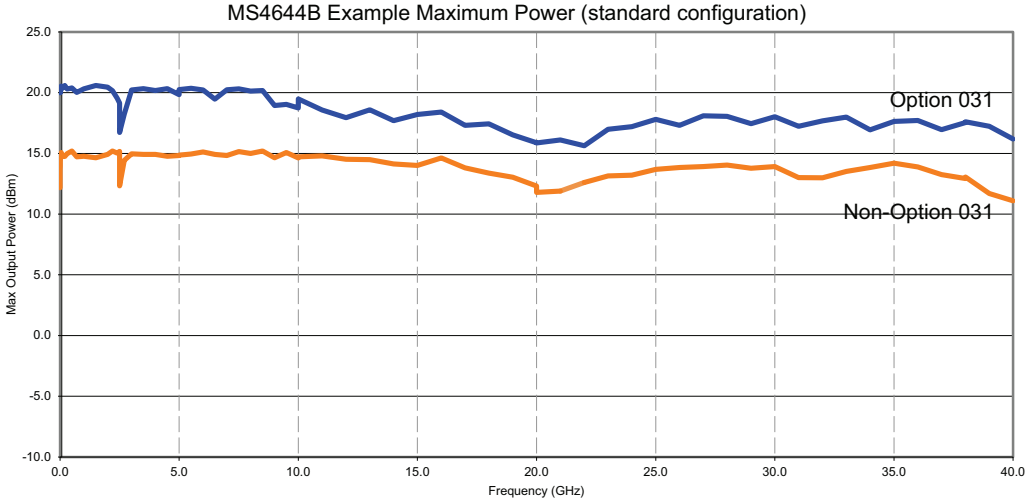
b. Rated power is typical 49 GHz to 50 GHz.

c. With Option 08x, Test Port 2 maximum power is equivalent to the non-option 031 range (typical). 38 to 50 GHz range may degrade by up to 3 dB.

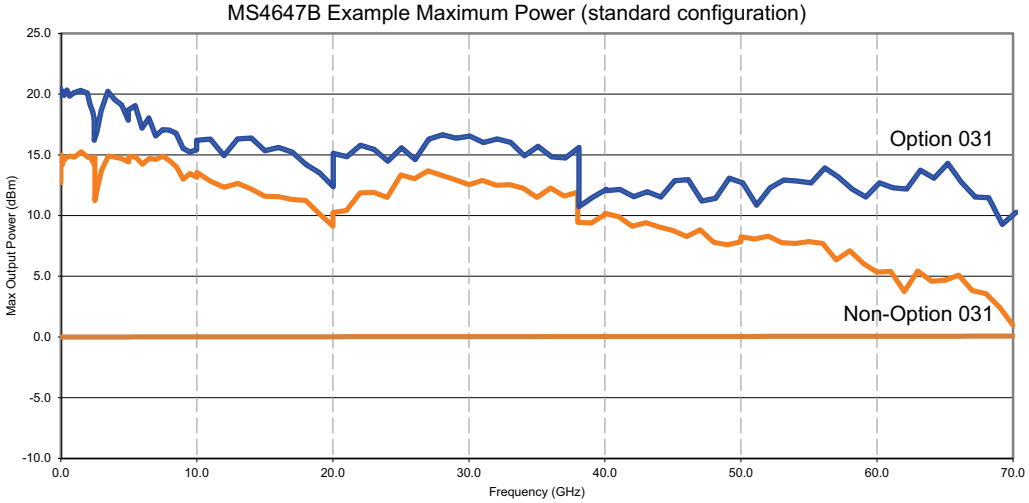
MS4642B Example Maximum Power (standard configuration)



MS4644B Example Maximum Power (standard configuration)



MS4647B Example Maximum Power (standard configuration)



Output Default Power

Instrument default power. For maximum rated power, refer to "Power Range" above.

Model	Standard (No Options)	Option 051, 061 or 062
MS4642B, 20 GHz	+5 dBm	+5 dBm
MS4644B, 40 GHz	+5 dBm	+5 dBm
MS4645B, 50 GHz	–3 dBm	–10 dBm
MS4647B, 70 GHz	–3 dBm[a]	–10 dBm

a. -5 dBm for MS4647B Option 08x systems.

Power Accuracy, Linearity, and Resolution

Frequency (GHz)	Accuracy[a] (dB)	Linearity[b] (dB)	Resolution (dB)
70 kHz to 0.01	± 1.5	± 1.5	0.01
> 0.01 to 40	± 1.5	± 1.0	0.01
> 40 to 67	± 3.0	± 1.0	0.01
> 67 to 70	± 4.0 (± 3.0)	± 2.0 (± 1.0)	0.01

a. Measured at default power.

b. Measured between default and 5 dB below default port power.

Measurement Stability

Ratio measurement, with ports shorted. Characteristic.

Frequency (GHz)	Magnitude (dB/°C)	Phase (degree/°C)
70 kHz to 0.01	< 0.04	< 0.4
> 0.01 to 20	< 0.02	< 0.2
> 20 to 40	< 0.03	< 0.5
> 40 to 67	< 0.03	< 0.7
> 67 to 70	< 0.04	< 0.8

Frequency Resolution, Accuracy, and Stability

Resolution	Accuracy	Stability
1 Hz	± 5 x 10^{-7} Hz/Hz (at time of calibration)	< 5 x 10^{-9}/°C over 0 °C to 50 °C temperature < 1 x 10^{-9}/day aging, instrument on

Phase Noise, Harmonics, and Non-Harmonics (Spurious)

Measured at default power. Non-Harmonics are characteristic performance.

Frequency (GHz)	SSB Phase Noise (dBc/Hz) at 10 kHz offset	Harmonics (dBc) (second and third)	Non-Harmonic Spurious (dBc) at > 1 kHz offsets
70 kHz to 0.01	–78	–20	–20
> 0.01 to 2.5	–84	–20	–30
> 2.5 to 5	–84	–20[a]	–30
> 5 to 10	–78	–20	–30
> 10 to 20	–72	–20	–30
> 20 to 40	–66	–20[a]	–30
> 40 to 67	–61	–20	–30
> 67 to 70	–61	–20	–30

a. Typical from 2.5 to 2.7 GHz on MS4642B systems and from 20.0 to 21.0 GHz on MS4645B or MS4647B systems.

Uncorrected (Raw) Port Characteristics

Characteristic performance with Options 031, 051, 061, or 062.

Frequency Range (GHz)	Directivity (dB)	Port Match[a] (dB)
70 kHz to 0.01	> 10[b]	> 8
> 0.01 to 2.5	> 9[b]	> 10
> 2.5 to 5	> 20	> 10
> 5 to 20	> 17	> 9
> 20 to 40	> 14	> 7
> 40 to 65	> 11	> 7
> 65 to 67	> 11	> 7
> 67 to 70	> 5 (> 10)	> 7

a. Port Match is defined as the worst of source and load match.

b. Raw Directivity degraded to 4 dB (typical) below 300 kHz and in a 300 MHz window below 2.5 GHz.

Power Range with Option 032

Maximum Rated Power to minimum level. Option 032 System Dynamic range differs by the delta in max power.

SOURCE1 to PORT1 POWER RANGE (dBm)

Frequency	Standard	Option 051	Option 061 or 062
MS4642B, 20 GHz with Option 031 and Option 032			
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –95
> 0.01 to 2.5 GHz	+12 to –25	+11 to –25	+10 to –95
> 2.5 to 20 GHz	+12 to –20	+11 to –20	+10 to –90
MS4644B, 40 GHz with Option 031 and Option 032			
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –95
> 0.01 to 2.5 GHz	+12 to –25	+11 to –25	+10 to –95
> 2.5 to 20 GHz	+10 to –20	+9 to –20	+8 to –90
> 20 to 40 GHz	+10 to –25	+9 to –25	+8 to –95
MS4645B and MS4647B, 50 GHz and 70 GHz with Option 031 and Option 032			
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –85
> 0.01 to 2.5 GHz	+12 to –25	+11 to –25	+10 to –85
> 2.5 to 5 GHz	+6 to –20	+5 to –20	+3 to –80
> 5 to 20 GHz	+6 to –20	+5 to –20	+3 to –80
> 20 to 38 GHz	+6 to –25	+4 to –25	+2 to –85
> 38 to 50 GHz	+5 to –25	+3 to –25	+1 to –85
> 50 to 65 GHz	+5 to –25	+3 to –25	+1 to –85
> 65 to 67 GHz	+3 to –25	+1 to –25	-1 to –85
> 67 to 70 GHz	+2 to –25	–1 to –25	–5 to –85

SOURCE2 to PORT2 POWER RANGE (dBm)

Frequency	Standard	Option 051	Option 061 or 062
MS4642B, 20 GHz with Option 031 and Option 032			
70 kHz to 0.01 GHz	+8 to –25	+7 to –25	+6 to –95
> 0.01 to 2.5 GHz	+10 to –25	+9 to –25	+8 to –95
> 2.5 to 20 GHz	+11 to –20	+10 to –20	+9 to –90
MS4644B, 40 GHz with Option 031 and Option 032			
70 kHz to 0.01 GHz	+8 to –25	+7 to –25	+6 to –95
> 0.01 to 2.5 GHz	+10 to –25	+9 to –25	+8 to –95
> 2.5 to 20 GHz	+7 to –20	+6 to –20	+5 to –90
> 20 to 40 GHz	+7 to –25	+6 to –25	+5 to –95
MS4645B and MS4647B, 50 GHz and 70 GHz with Option 031 and Option 032			
70 kHz to 0.01 GHz	+8 to –25	+7 to –25	+6 to –85
> 0.01 to 2.5 GHz	+10 to –25	+9 to –25	+8 to –85
> 2.5 to 5 GHz	+4 to –20	+3 to –20	+1 to –80
> 5 to 20 GHz	+3 to –20	+2 to –20	0 to –80
> 20 to 38 GHz	+4 to –25	+2 to –25	0 to –85
> 38 to 50 GHz[a]	+3 to –25	+1 to –25	–1 to –85
> 50 to 65 GHz	–2 to –25	–4 to –25	–6 to –85
> 65 to 67 GHz	–4 to –25	–5 to –25	–7 to –85
> 67 to 70 GHz	–5 to –25	–8 to –25	–12 to –85

a. Rated power is typical 49 GHz to 50 GHz.

SOURCE2 to PORT1 POWER RANGE (dBm)[a]

Frequency	Standard	Option 051 or 61	Option 062
MS4642B, 20 GHz with Option 031 and Option 032			
70 kHz to 0.01 GHz	–20 to –25	–21 to –25	–22 to –95
> 0.01 to 2.5 GHz	–13 to –25	–14 to –25	–15 to –95
> 2.5 to 20 GHz	–9 to –25	–10 to –25	–11 to –95
MS4644B, 40 GHz with Option 031 and Option 032			
70 kHz to 0.01 GHz	–20 to –25	–21 to –25	–22 to –95
> 0.01 to 2.5 GHz	–13 to –25	–14 to –25	–15 to –95
> 2.5 to 20 GHz	–9 to –25	–10 to –25	–11 to –95
> 20 to 40 GHz	–8 to –25	–9 to –25	–10 to –95
MS4645B and MS4647B, 50 GHz and 70 GHz with Option 031 and Option 032			
70 kHz to 0.01 GHz	–20 to –25	–21 to –25	–22 to –85
> 0.01 to 2.5 GHz	–13 to –25	–14 to –25	–15 to –85
> 2.5 to 5 GHz	–12 to –25	–13 to –25	–15 to –85
> 5 to 20 GHz	–11 to –25	–12 to –25	–14 to –85
> 20 to 38 GHz	–11 to –25	–13 to –25	–15 to –85
> 38 to 50 GHz	–12 to –25	–14 to –25	–16 to –85
> 50 to 65 GHz	–16 to –25	–18 to –25	–20 to –85
> 65 to 67 GHz	–17 to –25	–18 to –25	–20 to –85
> 67 to 70 GHz	–20 to –25	–23 to –25	–27 to –85

a.Typical

MS4642B 20 GHz VNA System Performance

MS4642B – 12-Term SOLT – Sliding Load – 3652A-1 K Calibration Kit

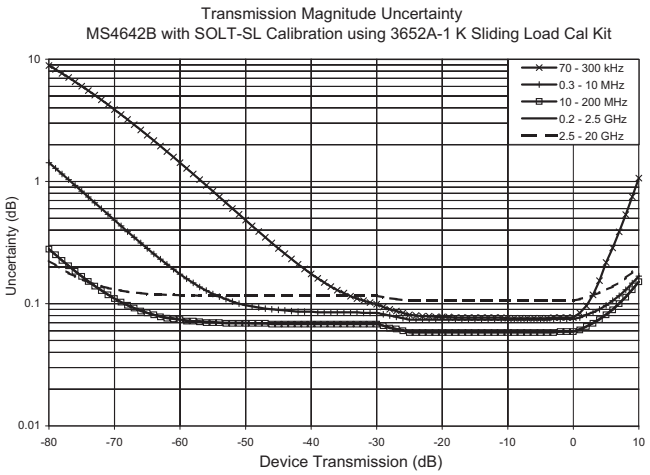
MS4642B 20 GHz Model, with 12-term SOLT with Sliding Load Calibration, using the 3652A-1 K Calibration Kit.

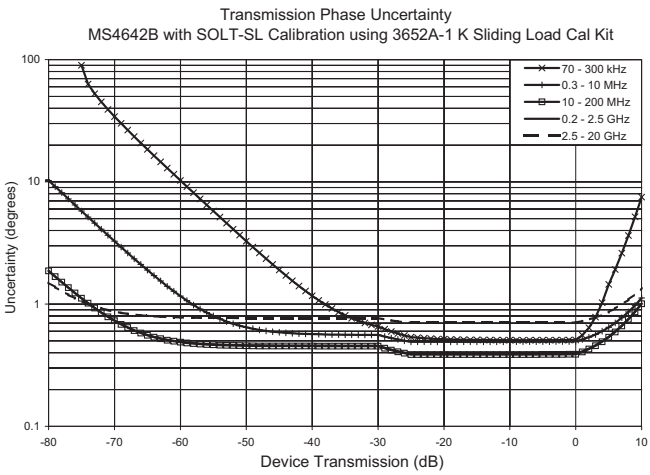
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 0.01	> 38	> 36	> 38	± 0.02	± 0.05
> 0.01 to 2.5	> 42	> 41	> 42	± 0.005	± 0.03
> 2.5 to 20	> 43	> 39	> 43	± 0.006	± 0.07

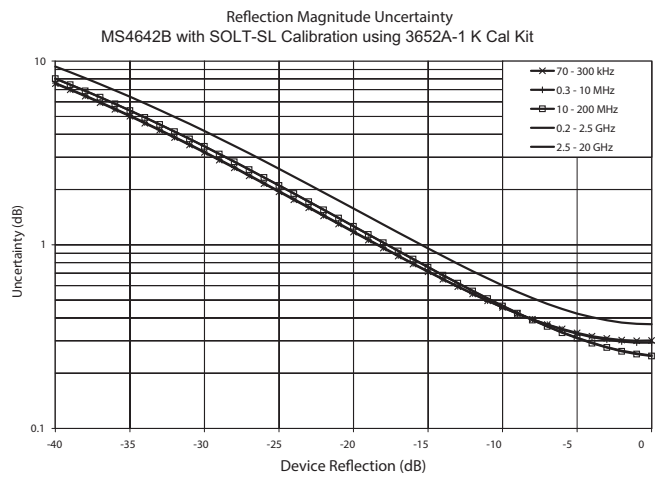
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

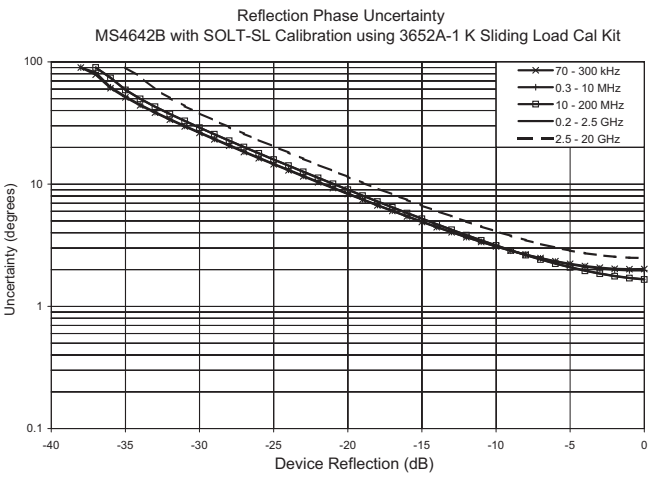
MS4642B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.









MS4642B – 12-Term SOLT – 3652A or 3652A-1 K Calibration Kit

MS4642B 20 GHz Model, with 12-term SOLT Calibration, using 3652A K or 3652A-1 K Cal Kit.

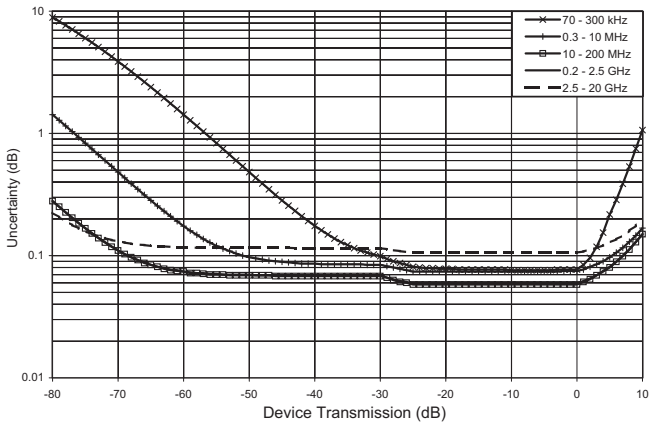
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match [a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 0.01	> 38	> 36	> 38	± 0.02	± 0.05
> 0.01 to 2.5	> 37	> 41	> 37	± 0.005	± 0.03
> 2.5 to 20	> 34	> 39	> 35	± 0.006	± 0.07

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

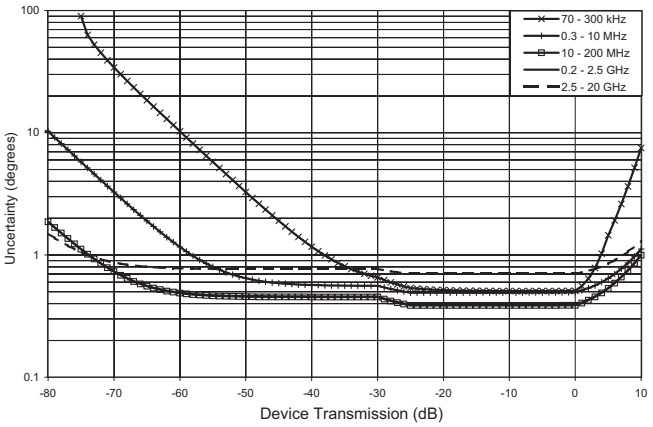
MS4642B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

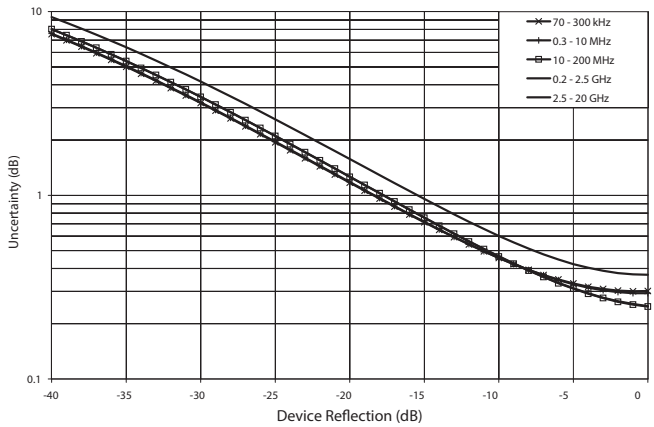
Transmission Magnitude Uncertainty
MS4642B with SOLT Calibration using 3652A K Cal Kit



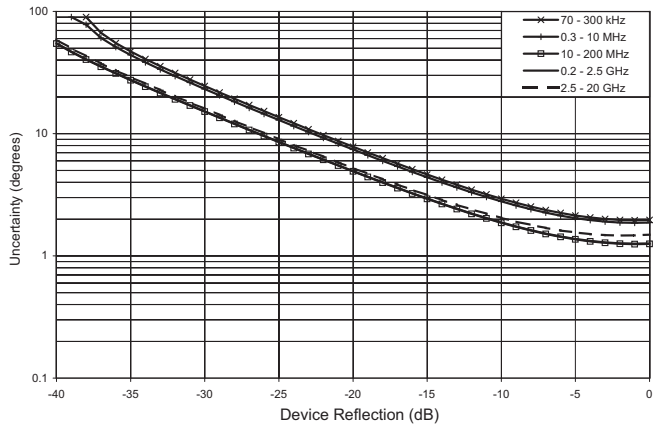
Transmission Phase Uncertainty
MS4642B with SOLT Calibration using 3652A K Cal Kit



Reflection Magnitude Uncertainty
MS4642B with SOLT-SL Calibration using 3652A-1 K Cal Kit



Reflection Phase Uncertainty
MS4642B with SOLT Calibration using 3652A K Cal Kit



MS4642B – 12-Term SOLT – Sliding Load – 3650A-1 3.5 mm Calibration Kit

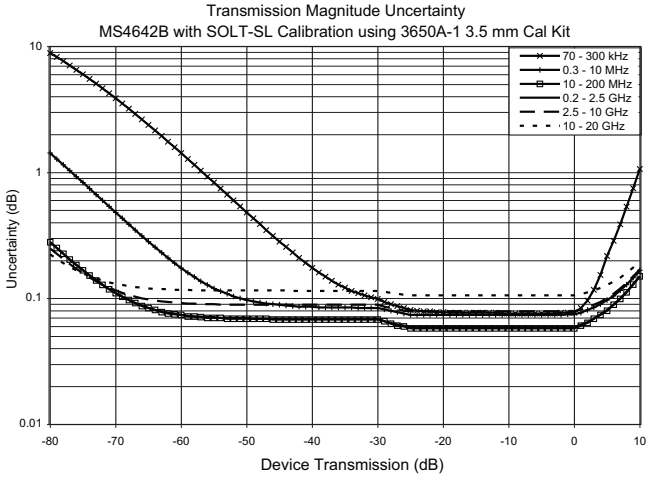
MS4642B 20 GHz Model, with 12-term SOLT Calibration with Sliding Load Calibration, using the 3650A-1 3.5 mm Cal Kit.

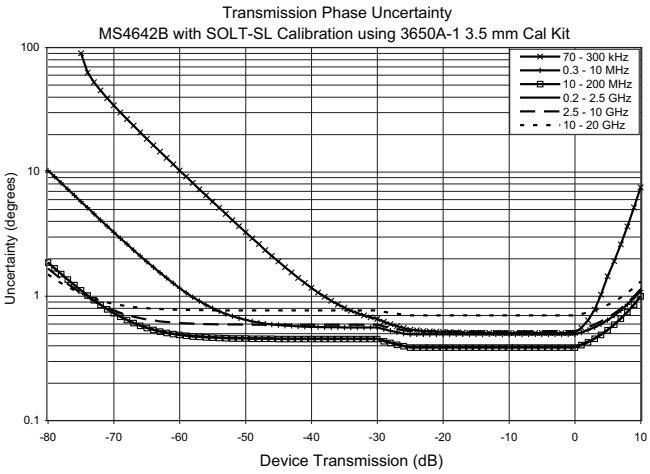
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 0.01	> 40	> 37	> 40	± 0.02	± 0.05
> 0.01 to 2.5	> 42	> 41	> 42	± 0.005	± 0.03
> 2.5 to 10	> 43	> 39	> 43	± 0.005	± 0.03
> 10 to 20	> 43	> 39	> 43	± 0.006	± 0.07

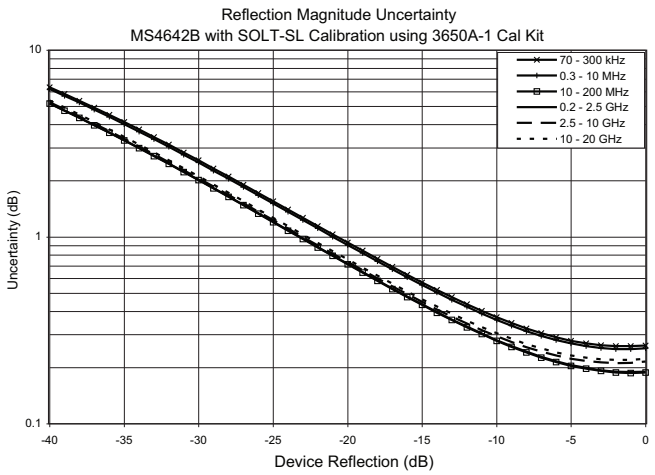
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

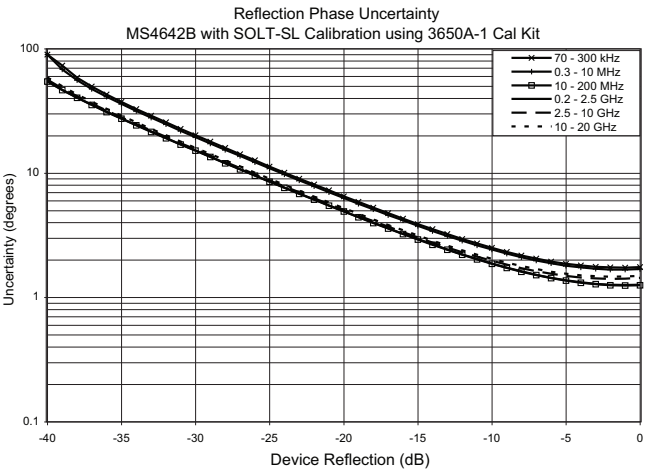
MS4642B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.









MS4642B – 12-Term SOLT – 3650A or 3650A-1 3.5 mm Calibration Kit

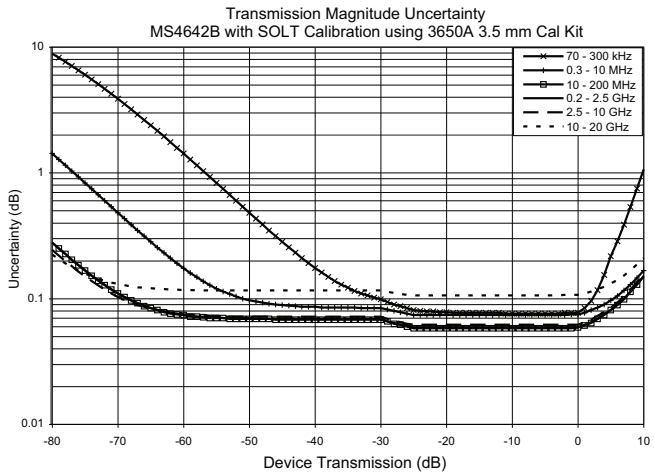
MS4642B 20 GHz Model, with 12-term SOLT Calibration, using the 3650A or 3650A-1 3.5 mm Cal Kit.

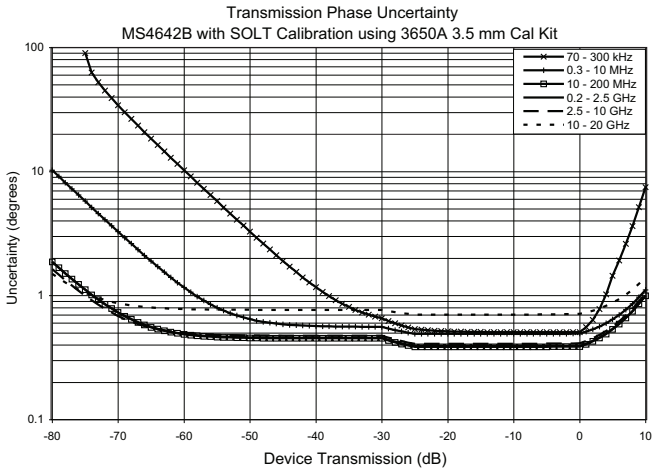
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 0.01	> 40	> 37	> 40	± 0.02	± 0.05
> 0.01 to 2.5	> 42	> 40	> 42	± 0.005	± 0.03
> 2.5 to 10	> 40	> 34	> 40	± 0.005	± 0.03
> 10 to 20	> 30	> 34	> 30	± 0.006	± 0.07

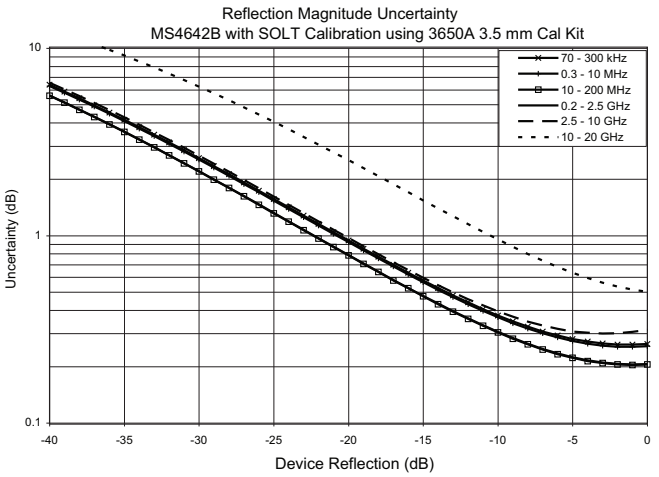
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

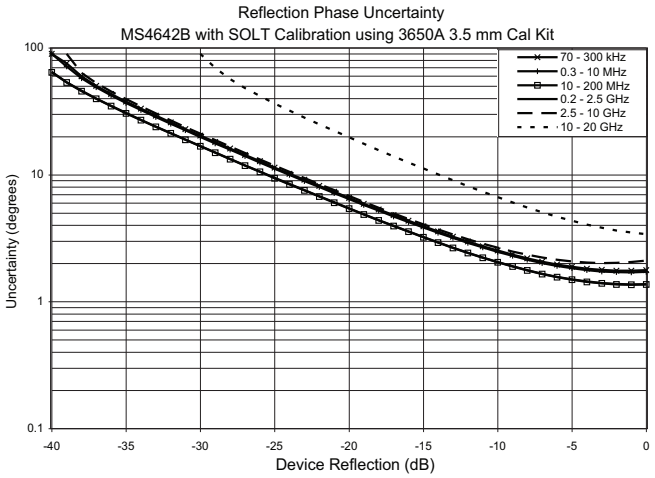
MS4642B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.









MS4642B – 12-Term – 36585K K AutoCal™

MS4642B 20 GHz Model, with 12-term Calibration, using the 36585K K Automatic Calibrator (AutoCal)

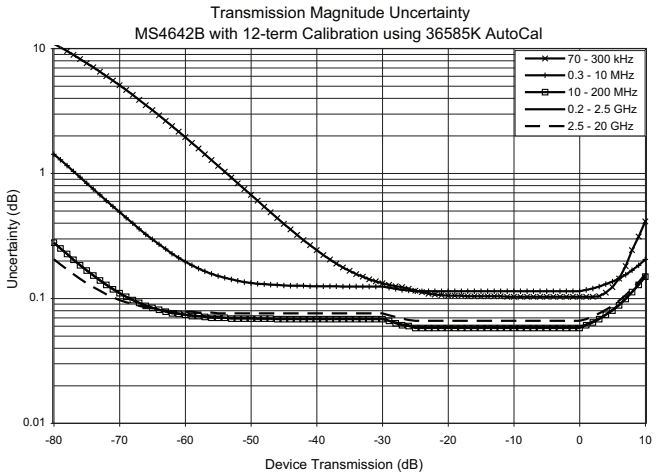
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 0.01 [b]	> 40	> 40	> 43	± 0.10	± 0.10
> 0.01 to 2.5	> 43	> 47	> 43	± 0.05	± 0.03
> 2.5 to 20	> 50	> 47	> 50	± 0.09	± 0.03

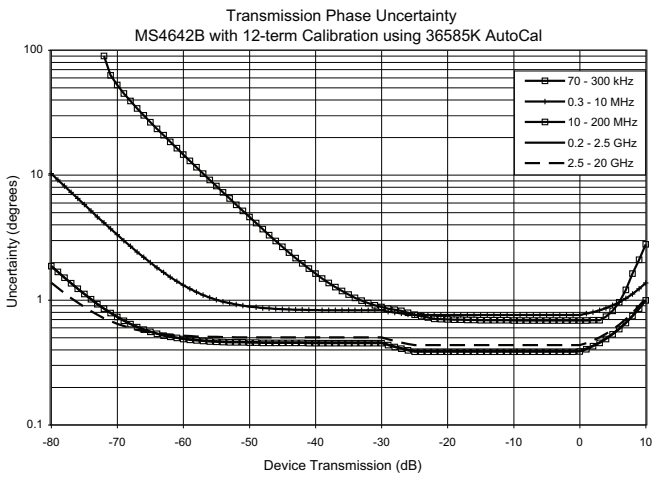
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

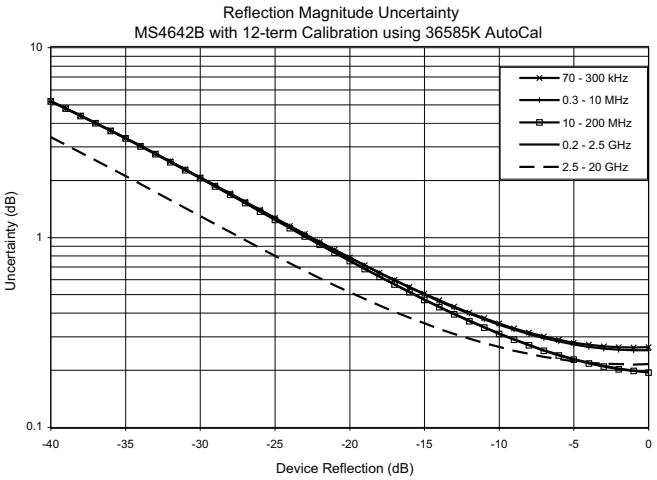
b. Typical performance below 2 MHz.

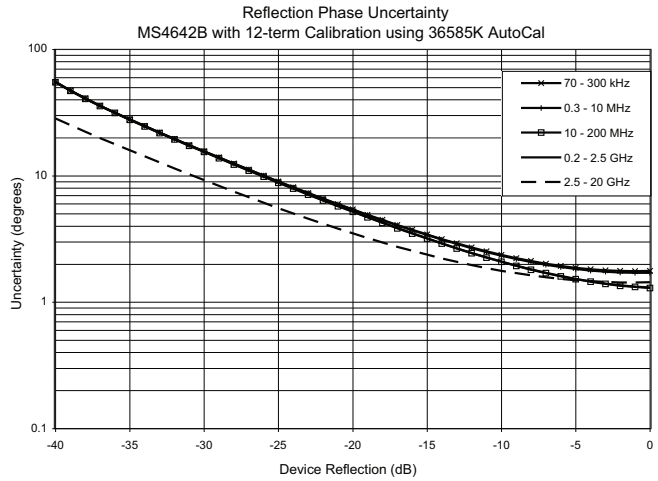
MS4642B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{21} = S_{12} = 0$. For reflection uncertainties, it is assumed that $S_{11} = S_{22} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.









MS4644B 40 GHz VNA System Performance

MS4644B – 12-Term SOLT – Sliding Load – 3652A-1 K Calibration Kit

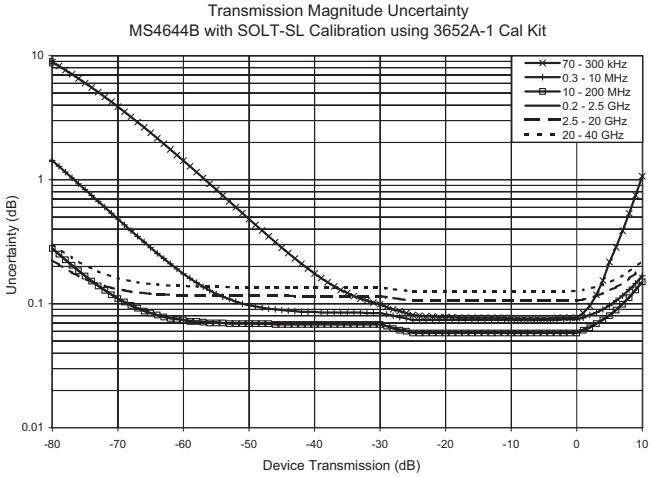
MS4644B 40 GHz Model, with 12-term SOLT with Sliding Load Calibration, using the 3652A-1 K Calibration Kit.

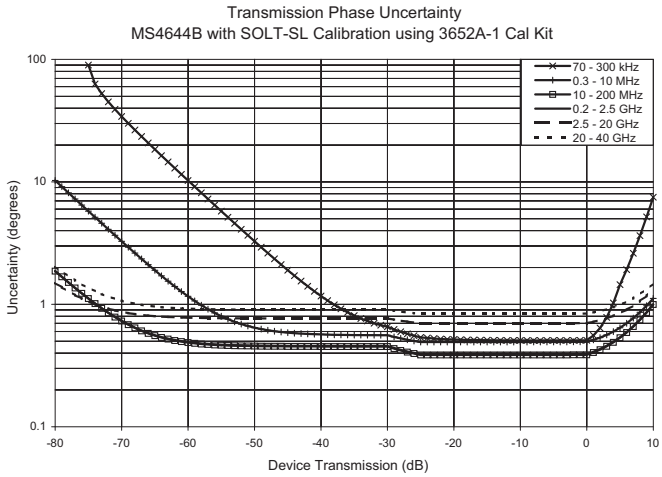
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 0.01	> 38	> 36	> 38	± 0.02	± 0.05
> 0.01 to 2.5	> 42	> 41	> 42	± 0.005	± 0.03
> 2.5 to 20	> 43	> 39	> 43	± 0.006	± 0.07
> 20 to 40	> 40	> 34	> 40	± 0.006	± 0.08

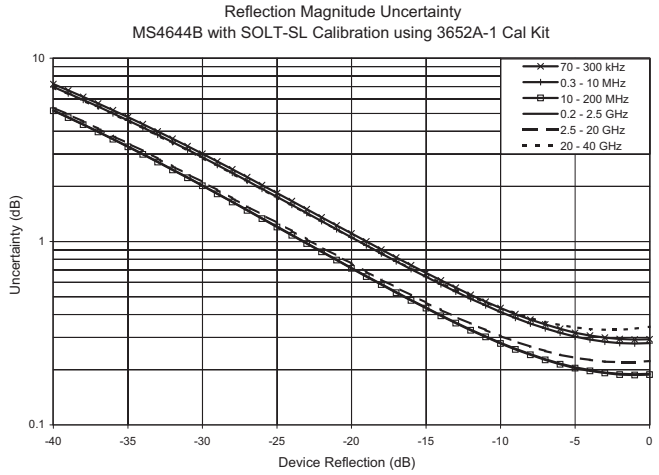
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified at Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

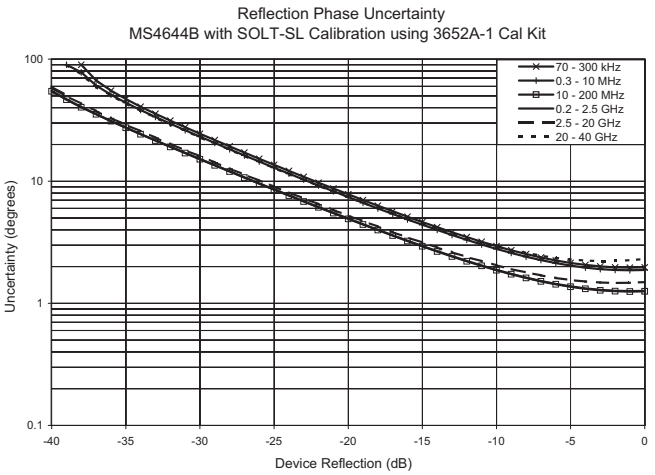
MS4644B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.









MS4644B – 12-Term SOLT – 3652A or 3652A-1 K Calibration Kit

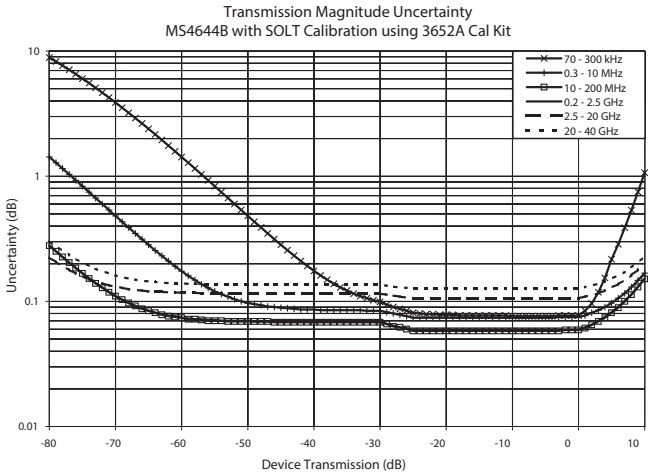
MS4644B 40 GHz Model, with 12-term SOLT Calibration, using the 3652A or 3652A-1 K Calibration Kit.

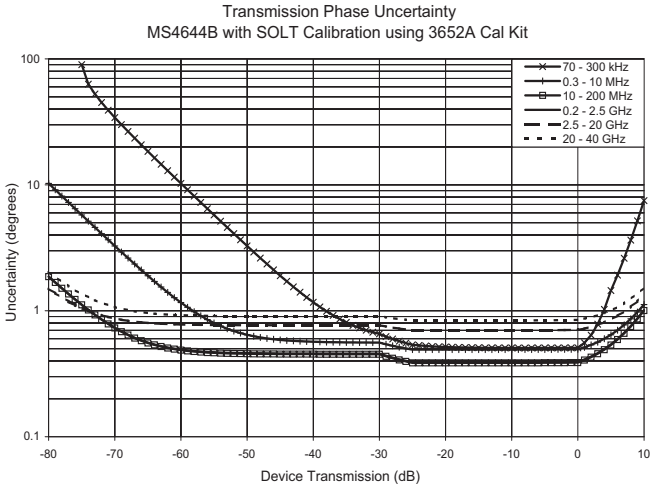
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 0.01	> 38	> 36	> 38	± 0.02	± 0.05
> 0.01 to 2.5	> 37	> 41	> 37	± 0.005	± 0.03
> 2.5 to 20	> 34	> 39	> 35	± 0.006	± 0.07
> 20 to 40	> 32	> 34	> 32	± 0.006	± 0.08

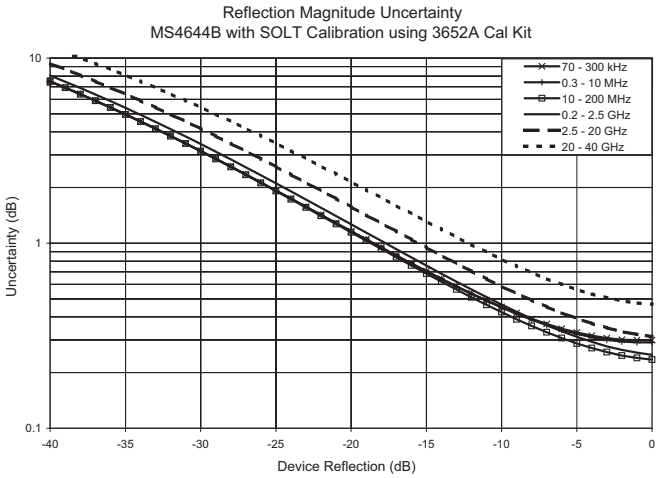
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

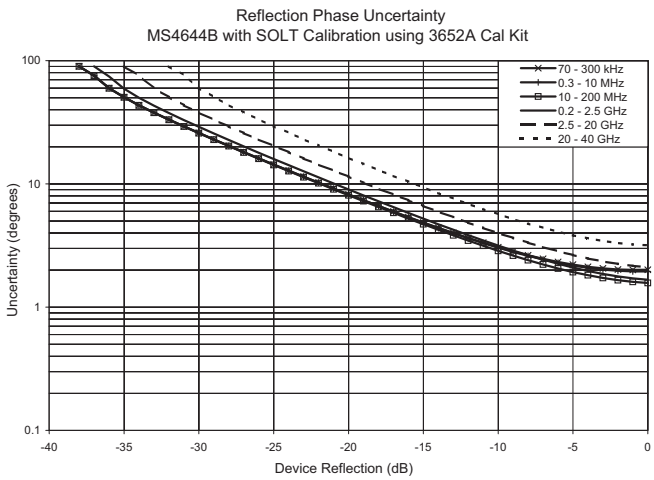
MS4644B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.









MS4644B – 12-Term – 36585K K AutoCal

MS4644B 40 GHz Model, with 12-term Calibration, using the 36585K K AutoCal.

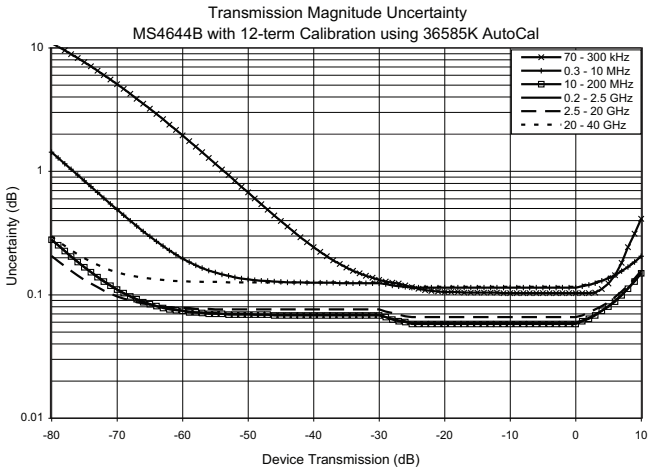
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 0.01 [b]	> 40	> 40	> 43	± 0.10	± 0.10
> 0.01 to 2.5	> 43	> 47	> 43	± 0.05	± 0.03
> 2.5 to 20	> 50	> 47	> 50	± 0.09	± 0.03
> 20 to 40	> 48	> 47	> 48	± 0.14	± 0.07

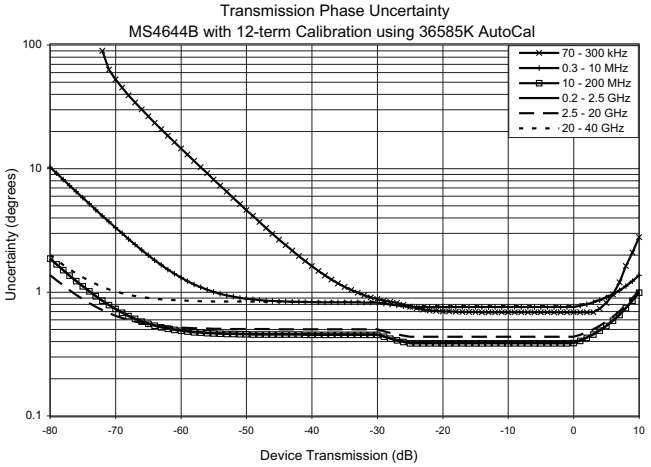
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

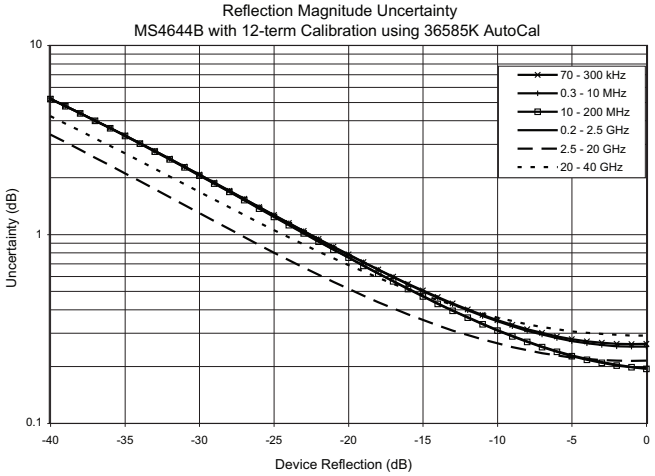
b. Typical performance below 2 MHz.

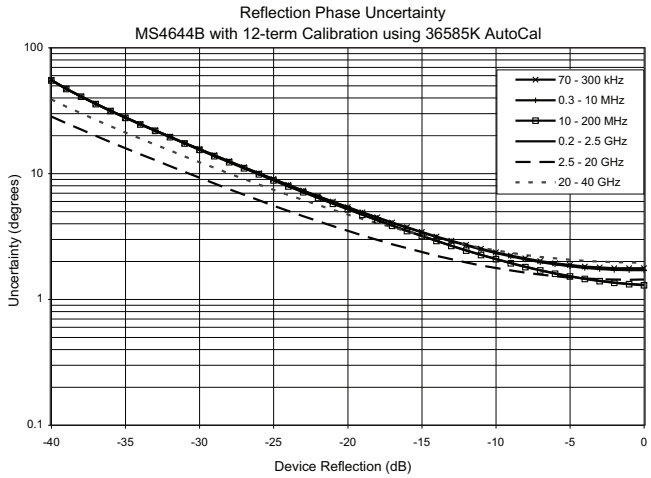
MS4644B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.









MS4645B 50 GHz / MS4647B 70 GHz VNA System Performance

MS4645B/MS4647B VNAs – 12-Term SOLT Sliding Load – 3654D-1 V Calibration Kit

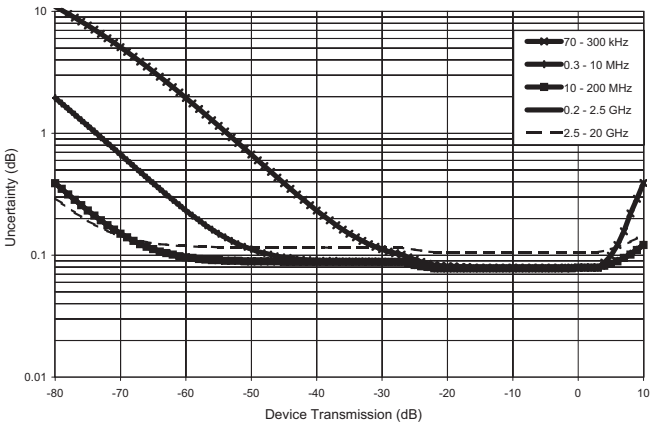
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 0.01	> 38	> 36	> 38	± 0.02	± 0.05
> 0.01 to 2.5	> 41	> 39	> 41	± 0.02	± 0.05
> 2.5 to 20	> 41	> 37	> 41	± 0.02	± 0.07
> 20 to 40	> 37	> 32	> 37	± 0.02	± 0.08
> 40 to 65	> 35	> 28	> 35	± 0.08	± 0.12
> 65 to 67	> 35	> 28	> 35	± 0.15	± 0.15
> 67 to 70	> 30	> 26	> 30	± 0.30	± 0.15

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

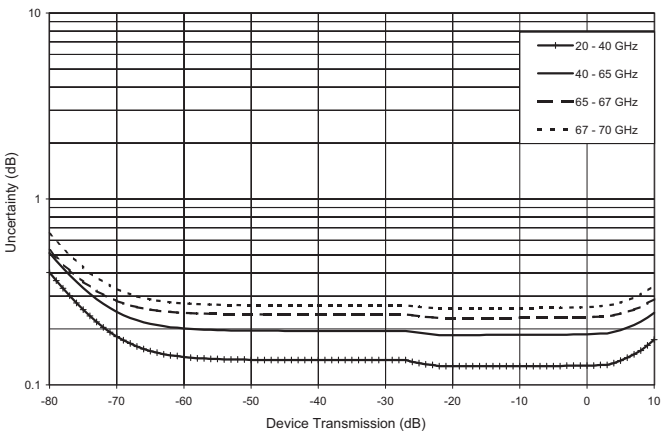
MS4645B/MS4647B Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

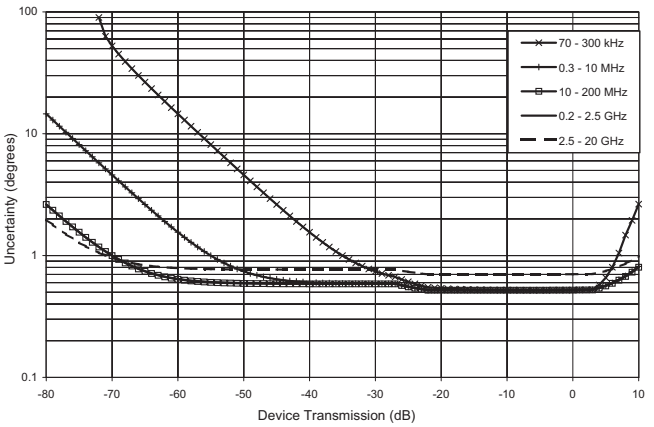
Transmission Magnitude Uncertainty (1 of 2)
MS4647B with SOLT-SL Calibration using 3654D-1 Cal Kit



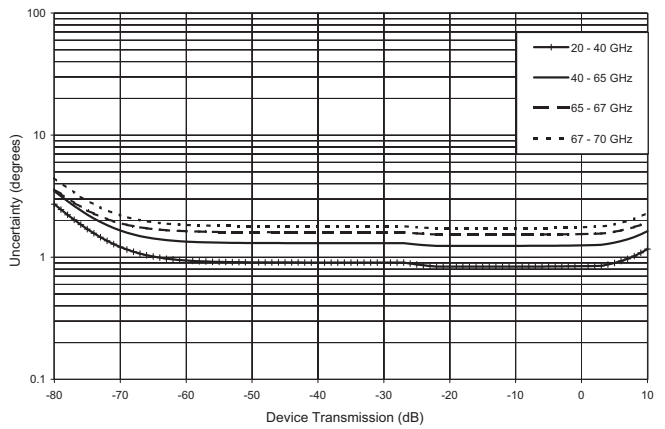
Transmission Magnitude Uncertainty (2 of 2)
MS4647B with SOLT-SL Calibration using 3654D-1 Cal Kit



Transmission Phase Uncertainty (1 of 2)
MS4647B with SOLT-SL Calibration using 3654D-1 Cal Kit



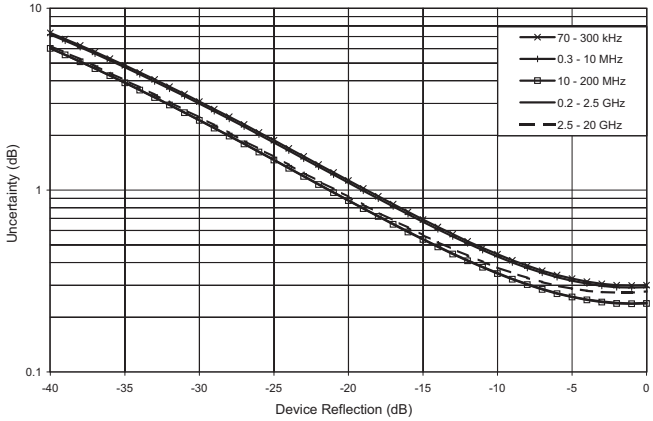
Transmission Phase Uncertainty (2 of 2)
MS4647B with SOLT-SL Calibration using 3654D-1 Cal Kit



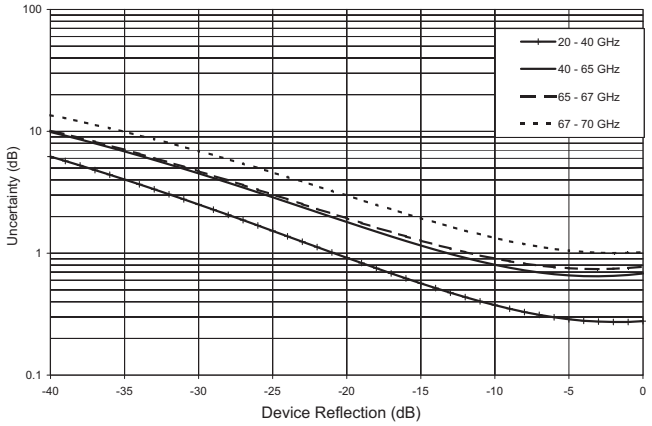
MS4645B/MS4647B Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

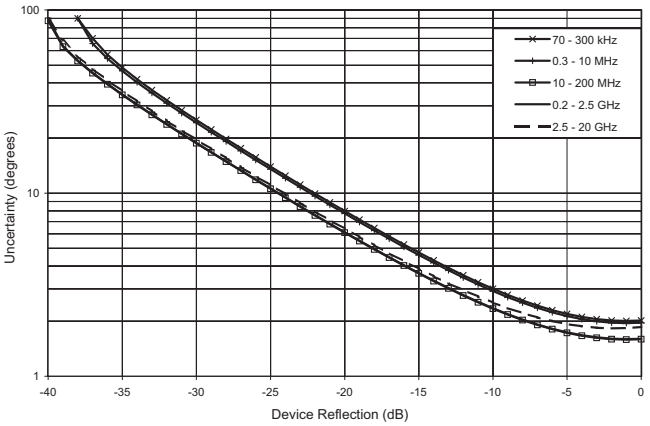
Reflection Magnitude Uncertainty (1 of 2)
MS4647B with SOLT-SL Cal with 3654D-1 Cal Kit



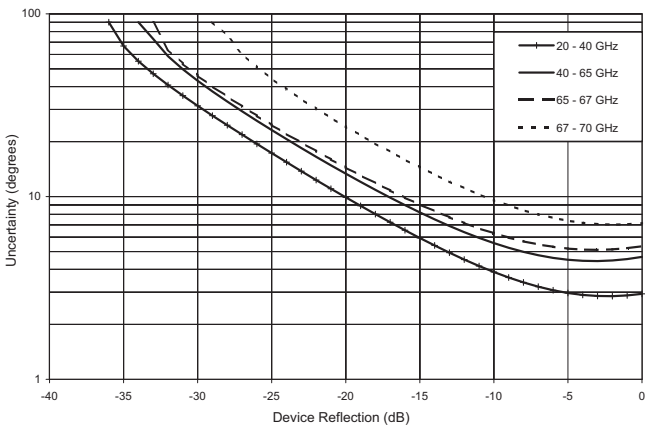
Reflection Magnitude Uncertainty (2 of 2)
MS4647B with SOLT-SL Cal with 3654D-1 Cal Kit



Reflection Phase Uncertainty (1 of 2)
MS4647B with SOLT-SL Cal with 3654D-1 Cal Kit



Reflection Phase Uncertainty (2 of 2)
MS4647B with SOLT-SL Cal with 3654D-1 Cal Kit



MS4645B/MS4647B VNAs – 12-Term SOLT – 3654D or 3654D-1 V Calibration Kit

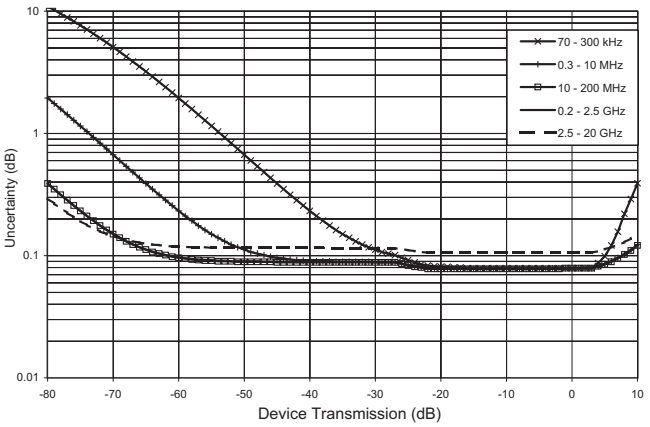
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 0.01	> 38	> 36	> 38	± 0.02	± 0.05
> 0.01 to 2.5	> 40	> 39	> 40	± 0.02	± 0.05
> 2.5 to 20	> 40	> 37	> 40	± 0.02	± 0.07
> 20 to 40	> 35	> 32	> 35	± 0.02	± 0.08
> 40 to 65	> 32	> 28	> 32	± 0.08	± 0.12
> 65 to 67	> 32	> 28	> 32	± 0.15	± 0.15
> 67 to 70	> 28	> 26	> 28	± 0.30	± 0.15

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

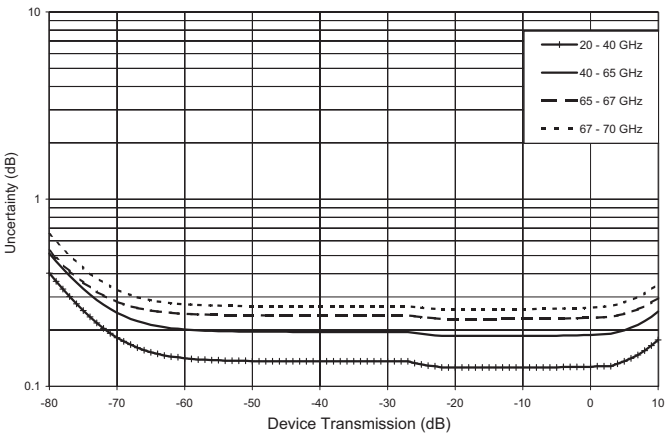
MS4645B/MS4647B Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

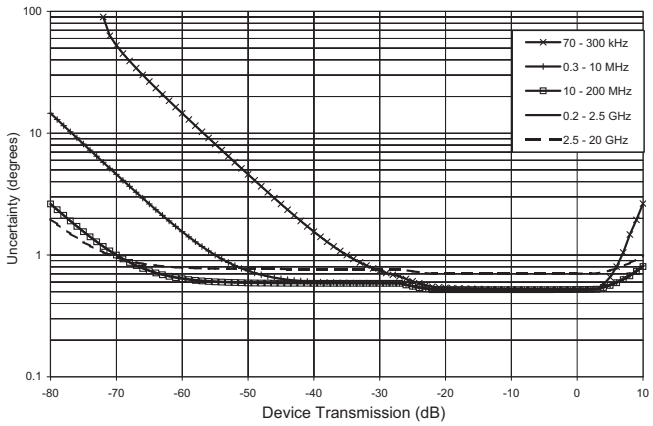
Transmission Magnitude Uncertainty (1 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



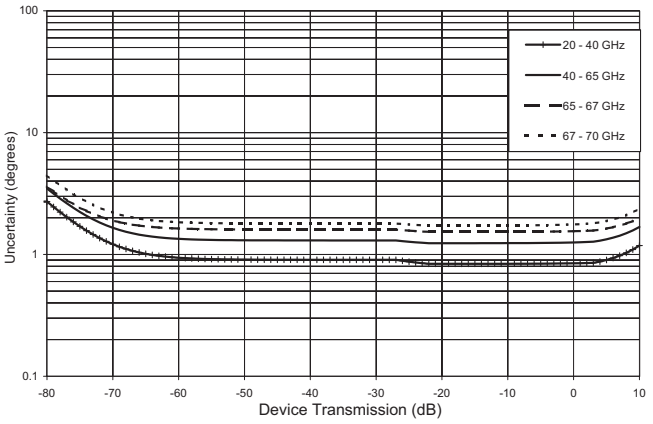
Transmission Magnitude Uncertainty (2 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



Transmission Phase Uncertainty (1 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



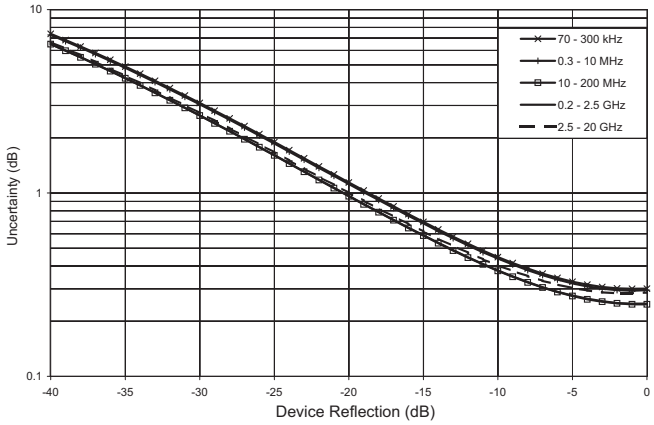
Transmission Phase Uncertainty (2 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



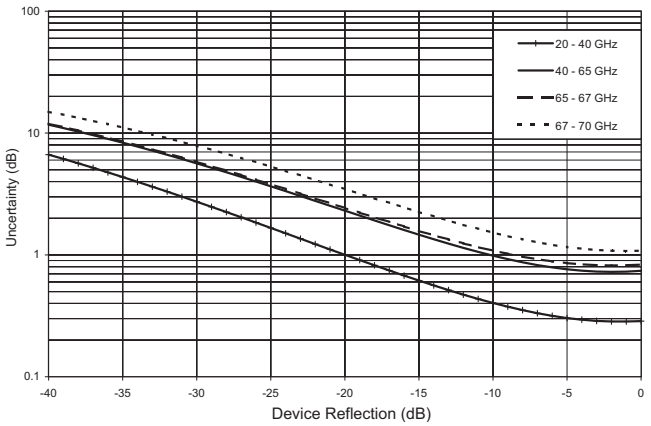
MS4645B/MS4647B Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

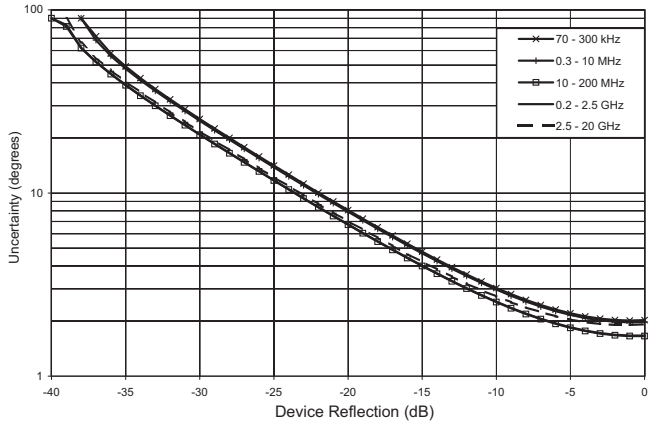
Reflection Magnitude Uncertainty (1 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



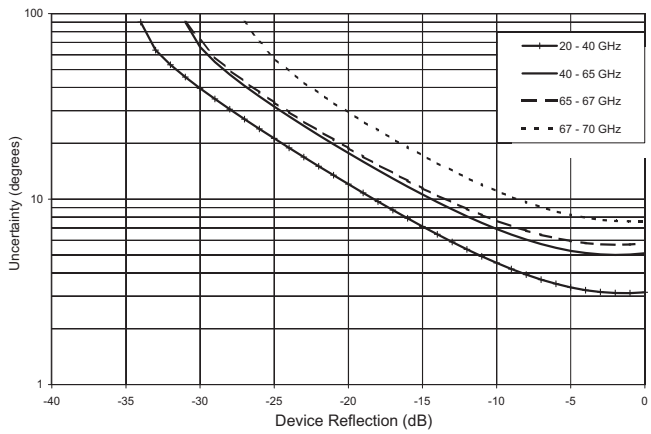
Reflection Magnitude Uncertainty (2 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



Reflection Phase Uncertainty (1 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



Reflection Phase Uncertainty (2 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



MS4645B/MS4647B VNAs – LRL – 3657-1 V Multi-Line Calibration Kit

MS4645B 50 GHz and MS4647B 70 GHz VNAs, with an LRL Calibration, using the 3657-1 V Multi-Line Calibration Kit, with symmetric reflects.

Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match [a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
0.24 [b] to 2.5	> 50	> 50	> 50	± 0.005	± 0.02
> 2.5 to 20	> 50	> 50	> 50	± 0.005	± 0.02
> 20 to 40	> 50	> 50	> 50	± 0.005	± 0.02
> 40 to 65	> 45	> 50	> 45	± 0.015	± 0.02
> 65 to 67	> 45	> 50	> 45	± 0.03	± 0.04
> 67 to 70	> 45	> 45	> 45	± 0.10	± 0.08

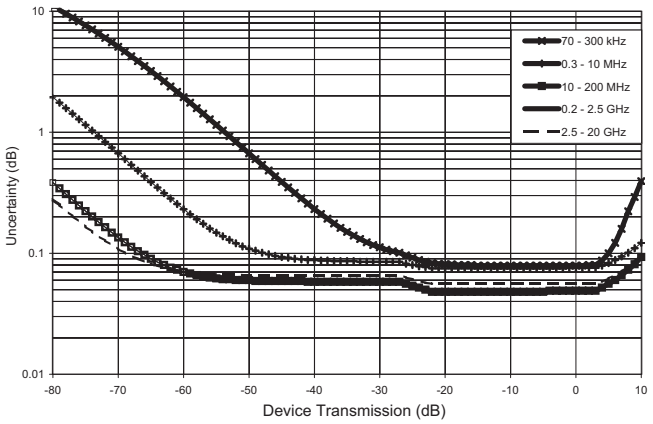
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

b. Limited to about 240 MHz, due to the longest line delta of 34.84 mm in the 3657 Series Multi-Line Calibration Kit.

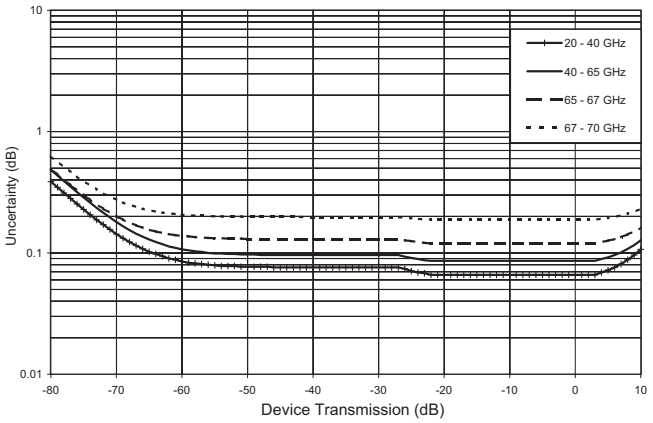
MS4645B/MS4647B Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

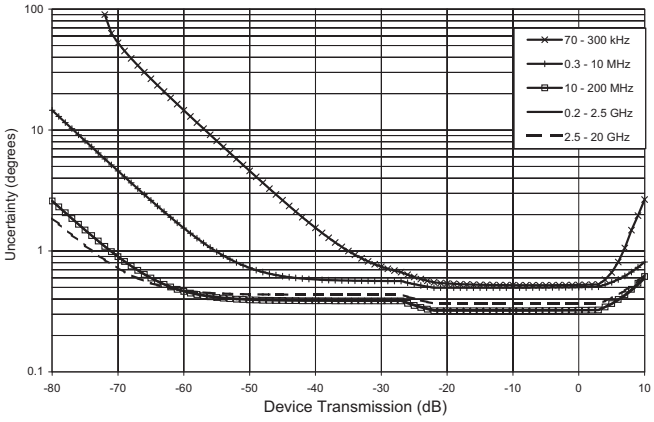
Transmission Magnitude Uncertainty (1 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



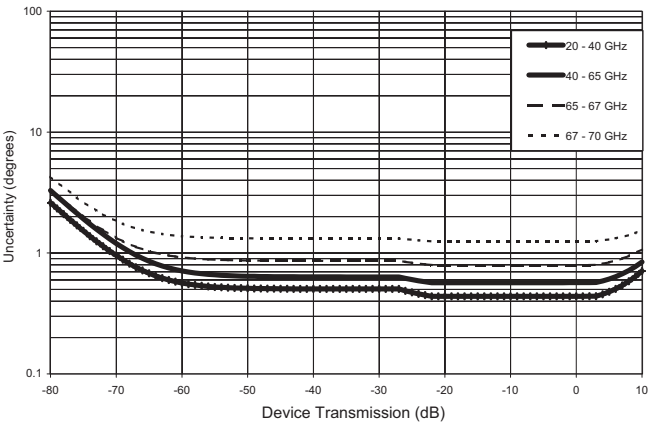
Transmission Magnitude Uncertainty (2 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



Transmission Phase Uncertainty (1 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



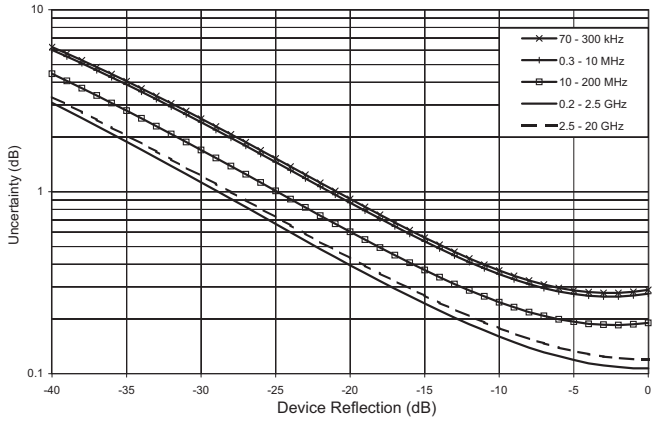
Transmission Phase Uncertainty (2 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



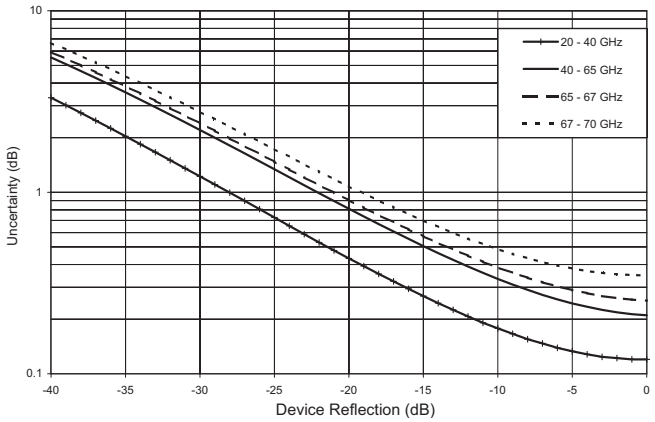
MS4645B/MS4647B Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

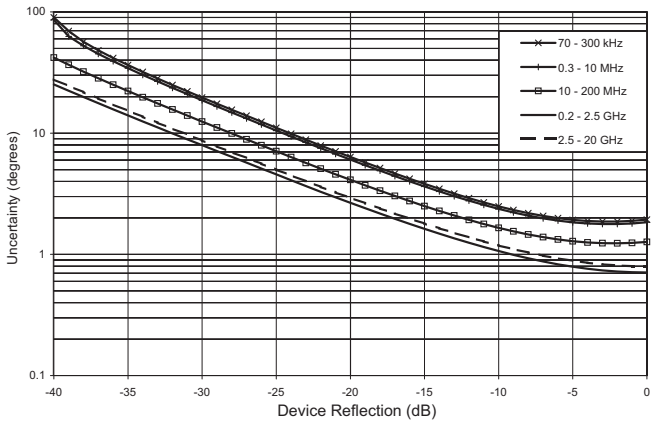
Reflection Magnitude Uncertainty (1 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



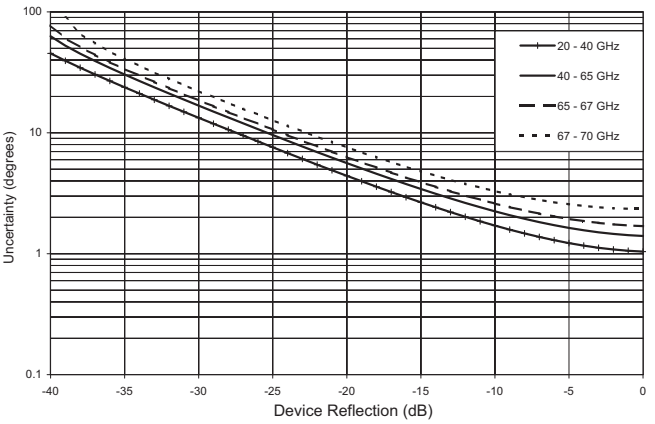
Reflection Magnitude Uncertainty (2 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



Reflection Phase Uncertainty (1 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



Reflection Phase Uncertainty (2 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



MS4645B/MS4647B VNAs – 12-Term – 36585V V AutoCal

MS4645B 50 GHz and MS4647B 70 GHz VNAs, with 12-term Calibration, using the 36585V V AutoCal.

Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match [a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 0.01 [b]	> 40	> 40	> 40	± 0.10	± 0.10
> 0.01 to 2.5	> 43	> 47	> 43	± 0.05	± 0.03
> 2.5 to 20	> 50	> 47	> 50	± 0.09	± 0.03
> 20 to 40	> 48	> 47	> 48	± 0.14	± 0.07
> 40 to 65	> 43	> 45	> 43	± 0.17 [c]	± 0.10
> 65 to 67	> 43	> 45	> 43	± 0.17	± 0.10
> 67 to 70	> 42	> 40	> 42	± 0.30	± 0.12

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

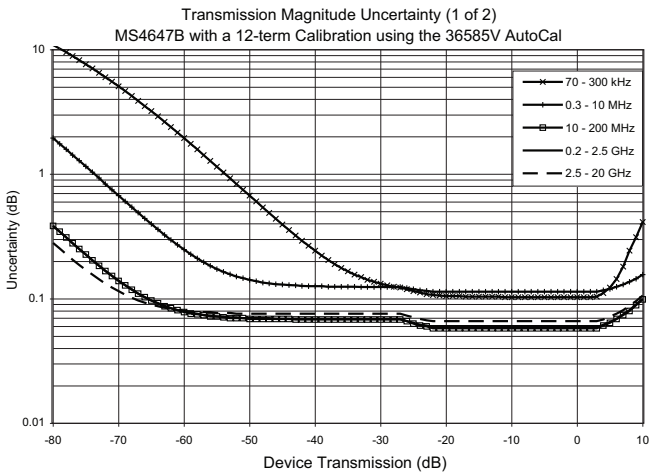
b. Typical performance below 2 MHz.

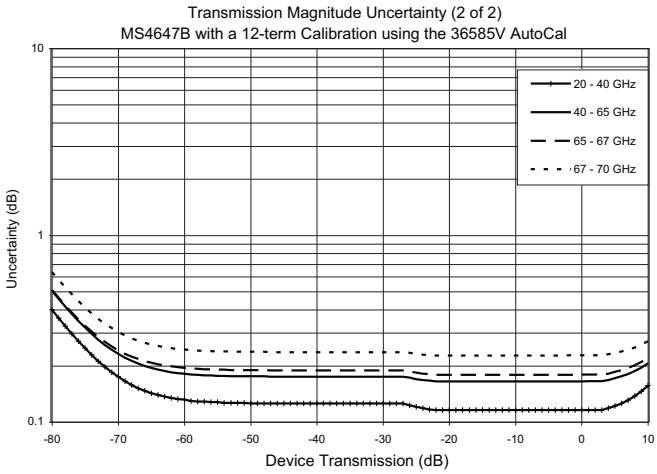
c. ± 0.25 dB from 51 to 55 GHz.

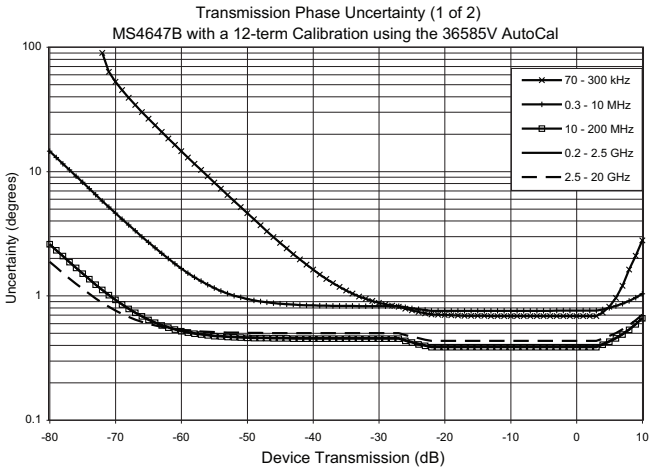
MS4645B/MS4647B Measurement Uncertainties (Transmission)

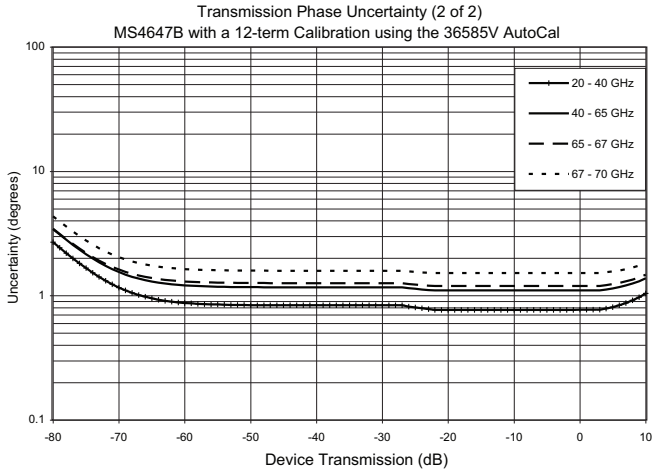
The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.

For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.





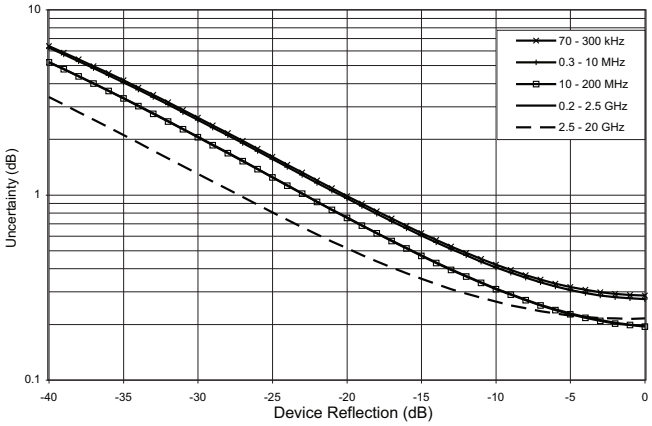




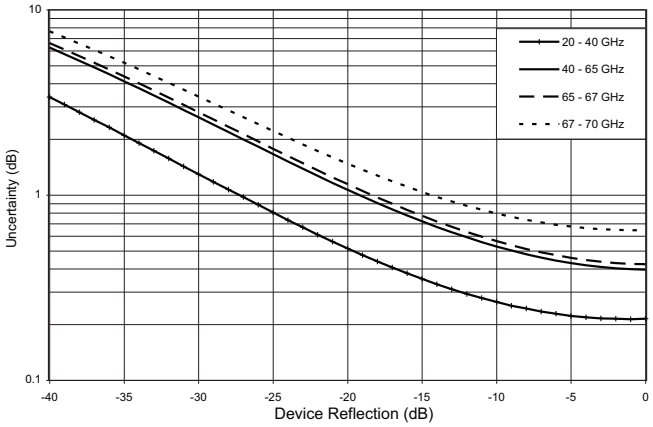
MS4645B/MS4647B Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using options 051, 061 or 062. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

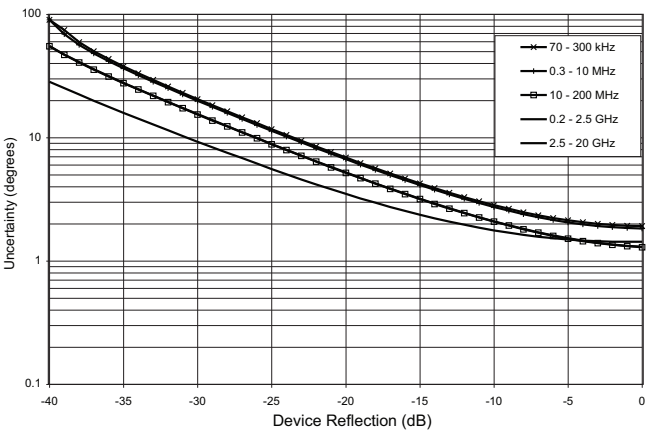
Reflection Magnitude Uncertainty (1 of 2)
MS4647B with a 12-term Calibration using the 36585V AutoCal



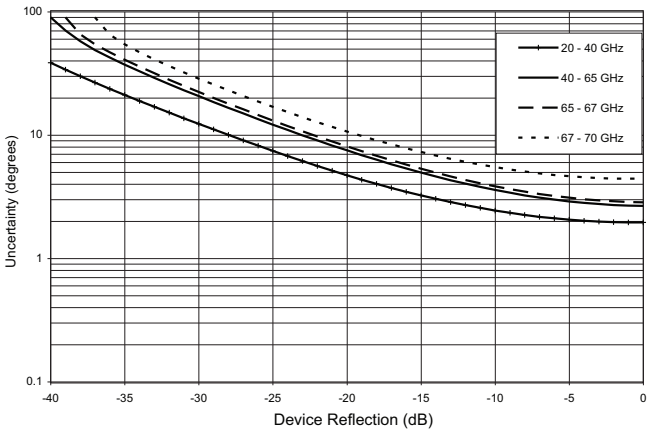
Reflection Magnitude Uncertainty (2 of 2)
MS4647B with a 12-term Calibration using the 36585V AutoCal



Reflection Phase Uncertainty (1 of 2)
MS4647B with a 12-term Calibration using the 36585V AutoCal



Reflection Phase Uncertainty (2 of 2)
MS4647B with a 12-term Calibration using the 36585V AutoCal



Measurement Times

Measurement times include sweep time, and band-switching time, in single channel mode. Typical.

20 μs/point is achieved in true swept mode, with 25,000 points, with ALC turned on for level accuracy, with display turned-on for tuning purposes, with locking turned-on for frequency accuracy and repeatability, with correction turned on to meet published residual specifications, and over the full span of the product with all band-switch points to fully characterize a device.

Measurement Time (ms), SYNTHESIZED Sweep, Display ON and ALC ON

Calibration	Sweep Width	IFBW	Measurement Time			
			401 Points	1,601 Points	25,000 Points	100,000 Points
Uncorrected or 1-port calibration	Narrow (≤ 1 GHz span without band-switch points)	1 MHz	14	40	510	2,200
		30 kHz	22	90	1,230	4,900
		1 kHz	380	1,600	25,000	100,000
	Wide (70 GHz span)	1 MHz	50	70	570	2,300
		30 kHz	67	120	1,300	5,000
		1 kHz	420	1,670	25,000	100,000
2-port calibration (per sweep)	Narrow (≤ 1 GHz span without band-switch points)	1 MHz	14	40	510	2,200
		30 kHz	22	90	1,230	4,900
		1 kHz	400	1,610	25,000	100,000
	Wide (70 GHz span)	1 MHz	50	70	570	2,300
		30 kHz	67	120	1,300	5,000
		1 kHz	420	1,670	25,000	100,000

Measurement Time (ms) vs. Noise Floor (dBm), SYNTHESIZED Sweep, Display ON and ALC ON

Calibration	Full Band Sweep	Measurement Time 1,601 Points	Achieved Noise Floor at Maximum Frequency (dBm)	IFBW (kHz)
2-port calibration (per sweep)	MS4642B	90	–85	100
		190	–95	10
	MS4644B	95	–80	100
		190	–90	10
	MS4645/47B	100	–75	100
		190	–85	10

Standard Capabilities

Operating Frequency	
MS4642B	10 MHz to 20.2 GHz
MS4644B	10 MHz to 40.5 GHz
MS4645B	10 MHz to 50.5 GHz
MS4647B	10 MHz to 70 GHz
MS4640B-070	Optional for all MS4640B Series VNAs. Provides 40 kHz to 10 MHz Coverage Extension. Provides a lower limit specified to 70 kHz, which is allowed to extend to 40 kHz.
Measurement Parameters	
2-Port Measurements	S_{11}, S_{21}, S_{22}, S_{12}, and any user-defined combination of a_1, a_2, b_1, b_2, and 1.
4-Port Measurements	Refer to the separate VectorStar MN469xC Series Multiport VNA Measurement System Technical Data Sheet – 11410-00777, available at www.anritsu.com/vectorstar
Domains	Frequency Domain, Power Domain, CW Draw, and Time (Distance) Domain
Sweeps	
Frequency Sweep Types	Linear, Log, CW, or Segmented
Power Sweep Types	Linear, constant power sweeps, or constant power slope (dB/GHz) over frequency sweep
Display Graphs	
Single Rectilinear Graph Types	Log Magnitude, Phase, Group Delay, Linear Magnitude, Real, Imaginary, SWR, Power Out, Impedance, and Power In
Dual Rectilinear Graph Types	Log Magnitude and Phase, Linear Magnitude and Phase, and Real and Imaginary
Circular Graph Types	Smith Chart (Impedance), Smith Chart (Admittance), Linear Polar, and Log Polar
Measurements Data Points	
25,000 Data Points	2 to 25,000 points in up to 16 channels
100,000 Data Points	2 to 100,000 points in single channel
Limit Lines	
Limit Lines	Single or segmented. 2 limit lines per trace. 50 segments per limit line.
Single Limit Readouts	Uses interpolation to determine the intersection frequency.
Test Limits	Both single and segmented limits can be used for PASS/FAIL testing.
Averaging	
Point-by-Point	Point-by-point (default), max Averaging = IF Bandwidth/1 Hz
Sweep-by-Sweep	Sweep-by-sweep (no limit)
IF Bandwidth	1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300, 500, 700 Hz; 1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300, 500, 700 kHz; 1MHz
Reference Plane	
Line Length or Time Delay	The reference planes of a calibration or other normalization can be changed by entering a line length or time delay.
Dielectric Constants	Dielectric constants may be entered for different media so the length entry can be physically meaningful.
Dispersion Modeling	Dispersion modeling is used in the cases of microstrip and waveguide to take into account frequency dependent phase velocities.
Attenuations	Attenuations (with frequency slope) and constant phase offsets can be entered to better describe any reference plane distortions.
De-embedding	For more complete reference plane manipulation, the full de-embedding system can also be used.
Measurement Frequency Range	
Frequency Range Change	Frequency range of the measurement can be narrowed within the calibration range without recalibration.
CW Mode	CW mode permits single frequency measurements also without recalibration.
Interpolation Not Activated	If interpolation is not activated, the subset frequency range is forced to use calibration frequency points.
Interpolation Activated	If interpolation is activated, any frequency range that is a subset of the calibration frequency range can be used, but there may be some added interpolation error.
Group Delay	
Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point.
Aperture	The aperture can be changed without recalibration.
Minimum Aperture	The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20 % of the frequency range.
Group Delay Range	< 180° of phase change within the aperture

Channels, Display, and Traces

Channels and Traces	16 channels, each with up to 16 traces
Display	Color touch screen LCD, 26.4 cm (10.4”) diagonal
Display Colors	Unlimited colors for data traces, memory, text, markers, graticules and limit lines.
Trace Memory and Math	A separate memory for each trace can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data. The trace data can be saved and recalled.
Intra-trace Math	Any two traces within a channel can also be combined (via addition, subtraction, multiplication or division) and displayed on another trace.

Scale Resolution

Minimum per division, varies with graph type.

Log Magnitude	0.001 dB
Linear Magnitude	1 *pu*
Phase	0.01°
Group Delay	0.001 ps
Time	0.001 ps
Distance	0.1 μm
SWR	1 *pu*
Power	0.01 dB

Markers

Markers	12 markers per trace (x 16 traces x 16 channels, for a total of 3,072)
Marker Coupling	Coupled or decoupled within a channel
Marker Data	Data displayed in graph area or in table form
Reference Marker	Additional marker per trace for reference
Marker Statistics	Mean, maximum, minimum, standard deviation Per trace or over a marker region.
Marker Search and Tracking	Search and/or track for minimum, maximum, peak, or target value.

Other

Filter Parameters	Display bandwidth (user-selectable loss value), corner and center frequencies, loss, Q, and shape factors.
Blank Frequency Information	Blanking function removes all references to frequencies on the display. Frequency references can only be restored through a system preset or GPIB command.

Remote Operability

VectorStar supports several remote operability options.

Communication Type	Data Format	Performance	Description
Via GPIB	Using IEEE 488.2	1 MB/s Data Transfer Speed	Use SCPI or previous generation Lightning VNA commands. Also compatible with a fundamental set of HP/Agilent 8510x VNA commands.
Via LAN	Using VXI-11 Protocol	2.5 MB/s Data Transfer Speed	
Via USB	Using USBTMC Protocol	5.5 MB/s Data Transfer Speed	
Drivers for GPIB, LAN, or USB	National Instruments LabVIEW and LabWindows/CVI drivers are available for download from both the Anritsu and National Instruments web sites. .NET/COM driver for Windows™ Applications such as Visual Studio 6 thru VS 2005, VB6, C#, C++, C, Visual C, HP Vee, and more are available for download from the Anritsu web site. These drivers require VISA runtime, not provided by Anritsu. NI VISA version 3.2 or higher is recommended for .NET and USB support.		
Triggering	Internal, External, GPIB Single point, Single Sweep, and Single Channel. All Channels are hand-shaking for optimum tandem sweeps (check rear panel connections).		

Throughput Time

Throughput Time (ms), Synthesized Sweep, Display ON and ALC ON, single 20 GHz sweep, 30 kHz IFBW, including trigger and data transfer time.

		Measurement Time (typical)		
Communication Type	Data Format	401 points	1,601 points	100,000 points
GPIB (IEEE-488.2)	32- or 64-bit Floating	380	410	6,400
	ASCII	290	370	7,400
LAN (VXI-11)	32- or 64-bit Floating	280	320	6,300
	ASCII	290	350	7,400
USB (USBTMC class)	32- or 64-bit Floating	280	310	6,000
	ASCII	290	350	6,800

Calibration and Correction Capabilities

Calibration Methods	Short-Open-Load-Through (SOLT) with Fixed or Sliding Load Offset-Short-Offset-Short-Load-Through (SSLT) with Fixed or Sliding Load Triple-Offset-Short-Through (SSST) Short-Open-Load-Reciprocal (SOLR) or Unknown Through Method (SSLR, SSSR) Line-Reflect-Line (LRL) / Line-Reflect-Match (LRM) Advanced-LRM (A-LRM™) for improved on-wafer calibrations AutoCal Thru Update available
Correction Models	2-Port (Forward, Reverse, or both directions) 1-Port (S_{11}, S_{22}, or both) Transmission Frequency Response (Forward, Reverse, or both directions) Reflection Frequency Response (S_{11}, S_{22}, or both)
Merged Calibration	Merge multiple calibrations over bands of frequency points and with different algorithms
Coefficients for Calibration Standards	Use the Anritsu calibration kit USB Memory Device to load kit coefficients and characterization files. Enter manual coefficients into user-defined locations. Use complex load models.
Reference Impedance	Modify the reference impedance from 50 Ω to any impedance greater than 0 Ω.
Interpolation	Allows interpolation between calibration frequency points.
Adapter Removal Calibration	Characterizes and "removes" an adapter that is used during calibration that will not be used for subsequent device measurements; for accurate measurement of non-insertable devices.
Dispersion Compensation	Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip.
Power	
Power Meter Correction	Different power meter calibrations are available to enhance power accuracy at the desired reference plane (to usually approximately 0.1 dB for short periods of time).
Flat Power Calibrations	A flat power calibration (when in frequency sweep mode) is available at a user-selectable power level, if it is within the power adjustment range of the internal source. The flat power correction is applied to other power levels.
Linear Power Calibrations	A linear power calibration is performed over a range of power levels for use in power sweep mode and is performed at a specified frequency or frequency range.
External Power Meter	Both calibrations are performed using an external power meter (Anritsu ML2438A, ML248xB, ML249xA, Agilent 437, or equivalent) over the Dedicated GPIB port.
Embedding/De-embedding	The MS4640B is equipped with an Embedding/De-embedding system.
De-embedding	De-embedding is generally used for removal of test fixture contributions, modeled networks and other networks described by S-parameters (s2p files) from measurements.
Embedding	Similarly, the Embedding function can be used to simulate matching circuits for optimizing amplifier designs or simply adding effects of a known structure to a measurement.
Multiple Networks	Multiple networks can be embedded/de-embedded and changing the port and network orientations is handled easily.
Extraction Utility	An extraction utility is part of this package that allows the easier computation of de-embedding files based on some additional calibration steps and measurements.
Impedance Conversion	Allows entry of different reference impedances (complex values) for different ports
Mixer Setup	Mixer setup provides assistance to configure common mixer measurements including a simple, yet accurate, calibration methodology.
Mixer Setup – Single Channel	The prime objective of the guided Mixer Setup Single Channel is to help configure the frequency plan of the measurement using easy-to-understand diagrams.
Mixer Setup – Multiple Channel	The Mixer Setup Multiple Channels helps configure measurement channels to handle any of a suite of possible mixer measurements and to list the required calibration steps.
Mixer Calibration	Both of these tools are coupled with the mixer calibration menu system that enables both scalar and vector-corrected measurements.
Dual Source Mixer	Allows easier external mixer setups and can take advantage of the flexibility of having two independent internal sources within the VNA.

Optional Capabilities

Time Domain Measurements – Option 002

Displays all S-parameters and overlays with Frequency Domain, Low-pass Mode with added harmonics frequency list flexibility, Band-pass Mode, Phasor Impulse Mode, Windowing, Gating (pass-band or reject-band), and Frequency with Time Gate.

Receiver Offset – Option 007

Independent Source/Receive Functions	Allows for independent source and receive functions for Mixer, Harmonics, IMD and other measurements, where the source and receive frequencies are offset.
Multiple Source Control Mode	To independently control the frequencies of up to four external sources, in addition to the internal source, and the receiver, in a synchronized manner.
NxN Frequency-Translated Devices	Provides calibration and measurements capability for NxN Frequency-translated devices. For accurate and absolute magnitude and phase measurements of match, gain/loss, and group delay of devices such as mixers and converters.

Dual Source Architecture — Option 031

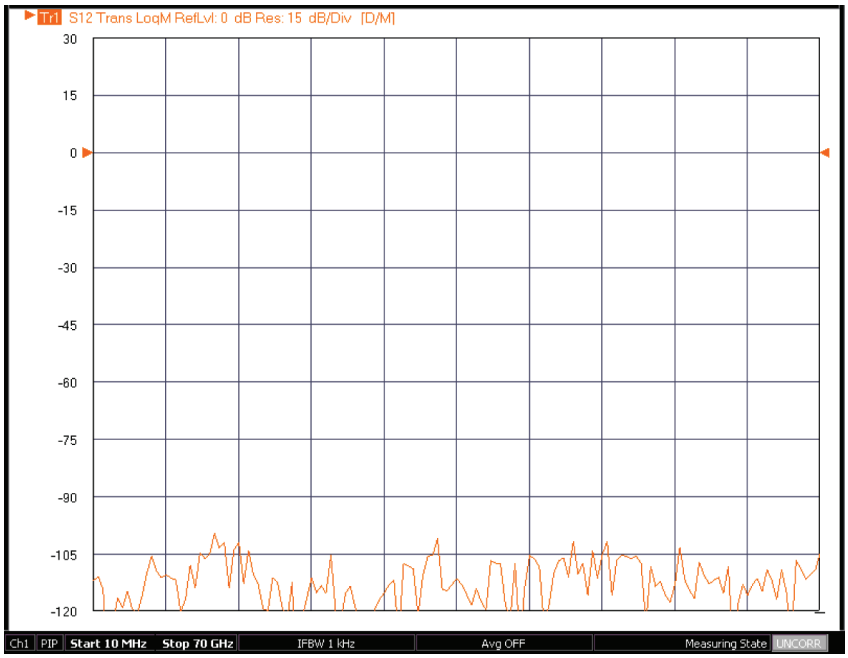
Description	Adds a second internal source to the VNA structure and removes the transfer switch. This architecture results in higher test port power and improved dynamic range. Combined with Option 007 Receiver Offset, allows two sources and the receiver to be active at the same time and at independent frequencies. When both sources are active and at the same frequency, a relative phase shift can be set between them. When combined with Option 043 DifferentialView™, adds the ability to perform true mode stimulus measurements of differential devices. The dual source mixer capability allows the flexibility of two independent sources within the VNA to allow external mixer measurements.
Required Options	None, except with the dual source mixer applications which require option 007.
System Compatible Options	Option 002 Time Domain Option 007 Receiver Offset Option 032 Internal RF Combiner Option 035 IF Digitizer Option 041 Noise Figure Option 042 PulseView™ Option 043 DifferentialView™ Option 044 IMDView™ Option 051 Direct Access Loops Options 061/062 Active Measurements Suite Option 070 70 kHz Low Frequency Extension Options 084/085 Broadband/Banded/Millimeter-Wave Extension Options 088/089 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz.
Incompatible Options	Options 080/081 Broadband/Millimeter-Wave Options 082/083 Banded/Millimeter-Wave Extension Options 086/087 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz.

Internal RF Combiner— Option 032

Description	Adds an internal combiner to combine Source 2 of the Dual Source Architecture option (Option 031) with Source 1 and routes to Port 1 of the VectorStar front panel. When combined with IMDView Option 044 the configuration provides optimized intermodulation distortion (IMD) measurements. The Frequency Offset (Option 007) and Dual Source (Option 031) must be ordered with the combiner option. If IMDView option 044 is not included, switching of the combiner is activated using the Multiple Source Control menus supplied with the frequency offset option.
Required Options	Option 007 Receiver Offset and Option 031 Dual Source Architecture
System Compatible Options	Option 002 Time Domain Option 035 IF Digitizer Option 041 Noise Figure Option 042 PulseView™ Option 043 DifferentialView™ Option 044 IMDView™ Option 051 Direct Access Loops Options 061/062 Active Measurements Suite Option 070 70 kHz Low Frequency Extension Options 084/085 Broadband/Banded/Millimeter-Wave Extension Options 088/089 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz.
Incompatible Options	Options 080/081 Broadband/Millimeter-Wave Options 082/083 Banded/Millimeter-Wave Extension Options 086/087 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz

IF Digitizer — Option 035

Description	When combined with Option 042 PulseView™, adds the capability to generate and measure pulsed signals. Four internal signal generators are included enabling singlet, doublet, triplet, quadruplet, and/or burst signal generation. Pulse measurements include pulse profile, point-in-pulse, and pulse-to-pulse capability.
Required Options	None
System Compatible Options	All
Incompatible Options	None
Multiport Systems	Compatible with the MN469xC Series Multiport System on any model VNA. Fast CW (non-pulsed) Captures up to 400 million data points per measurement channel with variable acquisition rates from 80 MHz to 400 MHz. This capability enables long time records (0.5 s to 2.5 s, depending on acquisition rate) stored in files retrievable via USB or a local area network.
Additional Information	For detailed pulse measurement theory, description, and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide, 10410-00318.



Typical plot of dynamic range with Option 035 activated.

Noise Figure – Option 041

Description	Adds the capability to measure degradation of the signal-to-noise ratio caused by components in a signal chain. The Noise Figure measurement is based on a cold source technique for improved accuracy. Various levels of match and fixture correction are available for additional enhancement.
Required Options	Option 051, Option 061, or Option 062
System Compatible Options	Option 002 Time Domain Option 007 Receiver Offset Option 031 Dual Source Architecture Option 032 Internal RF Combiner Option 035 IF Digitizer Option 042 PulseView™ Option 043 DifferentialView™ Option 044 IMDView™ Option 070 70 kHz Low Frequency Extension Option 081 Broadband/Millimeter-Wave Option 083 Millimeter-Wave Extension Option 085 Broadband/Banded/Millimeter-Wave Extension Option 087 Broadband/Millimeter-Wave Option 089 Broadband/Banded/Millimeter-Wave Extension
Incompatible Options	Option 080 Broadband/Millimeter-Wave Option 082 Banded Millimeter-Wave Extension Option 084 Broadband/Banded/Millimeter-Wave Extension Option 086 Broadband/Millimeter-Wave Option 088 Broadband/Banded/Millimeter-Wave Extension
Multiport System	MN469xC Series Multiport System on any model VNA; Noise Figure measurements can only be performed when the system is configured as a 2-Port VNA.
Additional Information	For detailed Noise Figure measurement theory, description, and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide, 10410-00318.

PulseView™ — Option 042

Description	When combined with Option 035 IF Digitizer, adds the capability to generate and measure pulsed signals. Four internal signal generators are included enabling singlet, doublet, triplet, quadruplet, and/or burst signal generation. Pulse measurements include pulse profile, point-in-pulse, and pulse-to-pulse capability.
Required Options	Option 035
System Compatible Options	All
Incompatible Options	None
Multiport Systems	Compatible with the MN469xC Series Multiport System on any model VNA
Additional Information	For detailed pulse generation and measurement capability theory, description, and operation information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide - 10410-00318.
Pulse Measurements	Pulse profile (PP), point-in-pulse (PIP), and pulse-to-pulse (P2P)
Minimum Profile Width	2.5 ns
Minimum PIP Measurement Width	2.5 ns
P2P Measurement Width	5 ns
Record Length	0.5 s
Pulse Repetition Frequency (PRF)	4 Hz to 67 MHz in Pulse mode; PRFs slower than 4 Hz can be measured in standard Transmission/Reflection mode with triggering.
Duty Cycle (DC) Dynamic Range Reduction (characteristic)	
1 % DC	0 dB
0.1 % DC	0 dB
0.01 % DC	0 dB
Pulse Generation	Four (4) internal pulse generators: PG1-PG4.
Pulse Formats	Singlet, doublet, triplet, quadruplet, and burst
Pulse Repetition Frequency (PRF) Range	4 Hz to 67 MHz
Maximum Pulse Width	0.25 s
Minimum Pulse Width	5 ns
RF Modulation	Requires a SM6628, SM6629, SM6630, or SM6631 Pulse Modulator Test Set (see next section)

RF Modulation (Pulse Modulator Test Sets for use with Option 042 PulseView™)

Description	Pulse Modulator Test Sets are available to pulse the RF stimulus and/or provide receiver gating (modulation). Receiver gating generally required only for higher power antenna and related applications where undesired pulses could saturate the VNA receiver. The Test Set frequency range is limited to that of the VNA with which it is used. Test Sets include necessary cabling and installation documentation.
Required Options	Option 035 IF Digitizer Option 042 PulseView™ Option 051 Direct Access Loops or Options 061/062 Active Measurements Suite
Requires one of the following compatible Pulse Modulator Test Sets	SM6628, 70 kHz to 40 GHz. Provides the MS4642B and MS4644B VNA with source modulation. SM6629, 70 kHz to 40 GHz. Provides the MS4642B and MS4644B VNA with source and receiver modulation. SM6630, 70 kHz to 70 GHz. Provides the MS4645B and MS4647B VNA with source modulation. SM6631, 70 kHz to 70 GHz. Provides the MS4645B and MS4647B VNA with source and receiver modulation.
Polarity	Low (< 1 V) = RF ON High (3.3 V ± 10 %) = RF OFF
Pulse Rise/Fall Time (typical)	5 ns (10 % to 90 %)
Insertion Loss (typical)	< 10 dB, to 20 GHz < 12 dB, 20 to 40 GHz < 15 dB, 40 to 60 GHz < 20 dB, 60 to 70 GHz
On/Off Ratio (typical)	> 100 dB, to 20 GHz > 95 dB, 20 to 60 GHz > 90 dB, 60 to 70 GHz
Max Input Power	+20 dBm max, 0 VDC max
Latency (typical)	35 ns

DifferentialView™ — Option 043

Description	When combined with Option 031 Dual Source Architecture, provides dual source control and calibrations required for stimulating and measuring differential devices. Allows true differential and common mode device drives. Corrects mismatch introduced error of the DUT to VNA interface via real and time calibration. This mode supports balanced in/out or combined balanced and single source drive configurations. In addition, it provides the ability to control amplitude and phase offsets of the drive conditions as well as swept phase offset for custom characterization.
Required Options	Option 031 Dual Source Architecture
System Compatible Options	All
Incompatible Options	None
Multiport Systems	Requires an MN469xC Series Multiport System for full differential characterization of a multiport device.

IMDView™— Option 044

Description	When combined with Options 031, 032, and 007, IMDView provides user interface for setting up and performing IMD measurements. Interface configures and controls source routing, power and receiver calibrations, for baseband or mmWave VectorStar systems. Frequency Offset Option 007 required. If Options 031 and/or 032 are not included, the IMDView software will control external sources and perform power calibrations of external combiners.
Required Options	Option 007
System Compatible Options	Option 002 Time Domain Option 007 Receiver Offset Option 031 Dual Source Architecture Option 032 Internal RF Combiner Option 035 IF Digitizer Option 042 PulseView™ Option 043 DifferentialView™ Option 051 Direct Access Loops Options 061/062 Active Measurements Suite Option 070 70 kHz Low Frequency Extension Options 084/085 Broadband/Banded/Millimeter-Wave Extension Options 088/089 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz. Options 080/081 Broadband/Millimeter-Wave Options 082/083 Banded/Millimeter-Wave Extension Options 086/087 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz Option 088 Broadband/Banded/Millimeter-Wave Extension
Multiport System	Compatible with the MN469xC Series Multiport System on any model VNA; IMDView measurements can only be performed when the system is configured as a 2-Port VNA..
Additional Information	For detailed IMD measurement theory, description and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide - 10410-00318.

Direct Access Loops — Option 051

Access Loops Per Port	Adds three (3) Access loops per port for Source, Test, and Receive Paths. Note: Direct access loops are not available for VNAs equipped with Options 061 or 062, which include access loops.
Front Panel Loops	≥ 2.5 GHz Frequency Coverage loops, located at front panel.
Rear Panel Loops	< 2.5 GHz Frequency Coverage loops, located at rear panel.

Active Measurements Suite – Options 061/062

Adds Step Attenuators, Bias Tees, Direct Access Loops, and Gain Compression and Efficiency Measurement Capabilities.

MS4642B and MS4644B Attenuators	70 dB, 10 dB/step
MS4645B and MS4647B Attenuators	60 dB, 10 dB/step
Option 061	Two (2) attenuators: One in Source 1 path, and one in Receive 2 path.
Option 062	Four (4) attenuators: One in each Source path and in each Receive path.
Bias Tees	0.5 A maximum, 40 VDC maximum 3 kHz BW (nominal), looking into a High Impedance 10 MΩ to Ground for DUT Static Discharge Protection located at rear panel.
Access Loops	Includes Option 051 loops, listed above. (Option 051, 061, and 062 are mutually exclusive)
Gain Compression	Swept Power Gain Compression at a CW frequency $P_{x\ dB}$ over Swept Frequency, up to 401 points.

70 kHz Low End Frequency Extension – Option 070

Extends the VNA standard 10 MHz low-end start frequency to 70 kHz, providing 70 kHz to 20, 40, 50, or 70 GHz coverage models. The low-end is allowed to extend to 40 kHz.

Broadband/Banded/Millimeter-Wave Systems For details on the MS464xB-08x series of options, see the:

VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593 (For 70 kHz to 125 GHz)

VectorStar ME7838D Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00778 (For 70 kHz to 145 GHz)

VectorStar ME7838E Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00767 (For 70 kHz to 110 GHz)

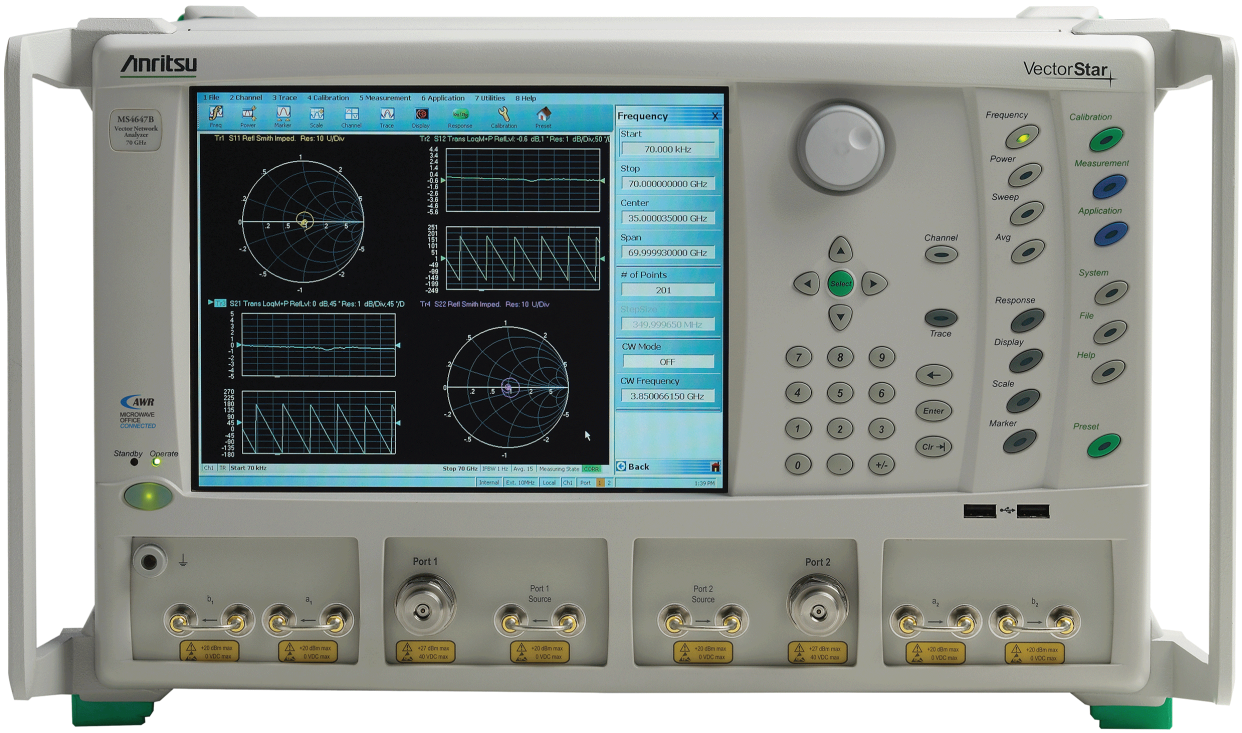
CPU, OS, Memory, and Security Features

CPU	Intel Core™ i5
O/S	The Microsoft® Windows® 7 operating system on the MS4640B Series VNA is configured for optimum performance when the instrument leaves the factory.
Display	26.4 cm (10.4") Color XGA Touch-Screen Display
Storage	Serial-ATA (SATA) Solid State Drive (SSD), for OS, Programs, and Data. (> 30 GB)

Security Features

Display Blanking	VectorStar™ software can obscure frequency and power levels on the system display for security.
Removable Internal Drive	Rear Panel accessible Solid State Drive (SSD) is quickly removable and easy to secure.
Option 004 Spare SSD	A bootable SSD module is available as a spare for VectorStar units used in multiple or compartmentalized locations. The VectorStar's operating system and software are pre-installed on each Option 004 SSD.
Virus Protection, Best Practices	If the VNA is attached to a network, best practices recommend installing anti-virus software. Trend Micro's Anti-Virus software products have been tested and are recommended by Anritsu for use with the MS4640B Series VNAs.

Front Panel Connections



MS4640B Front Panel

Test Ports 1 and 2

Type	Universal Test Port Connectors, easily exchangeable in case of damage.
MS4642B and MS4644B	K (male)
MS4645B and MS4647B	V (male)
Damage Input Levels	+27 dBm maximum, 40 VDC maximum

Direct Access Loops (optional)

Type	For Source, Test and Receive paths, 3 per port, for ≥ 2.5 GHz frequency coverage.
MS4642B and MS4644B	K (females)
MS4645B and MS4647B	V (females)
Damage Input Levels	+20 dBm maximum, 0 VDC maximum

USB Ports

Four type A USB 2.0 Ports (two each on the front and rear panel) for peripherals such as keyboard, mouse, memory stick, hardware key, and similar devices.

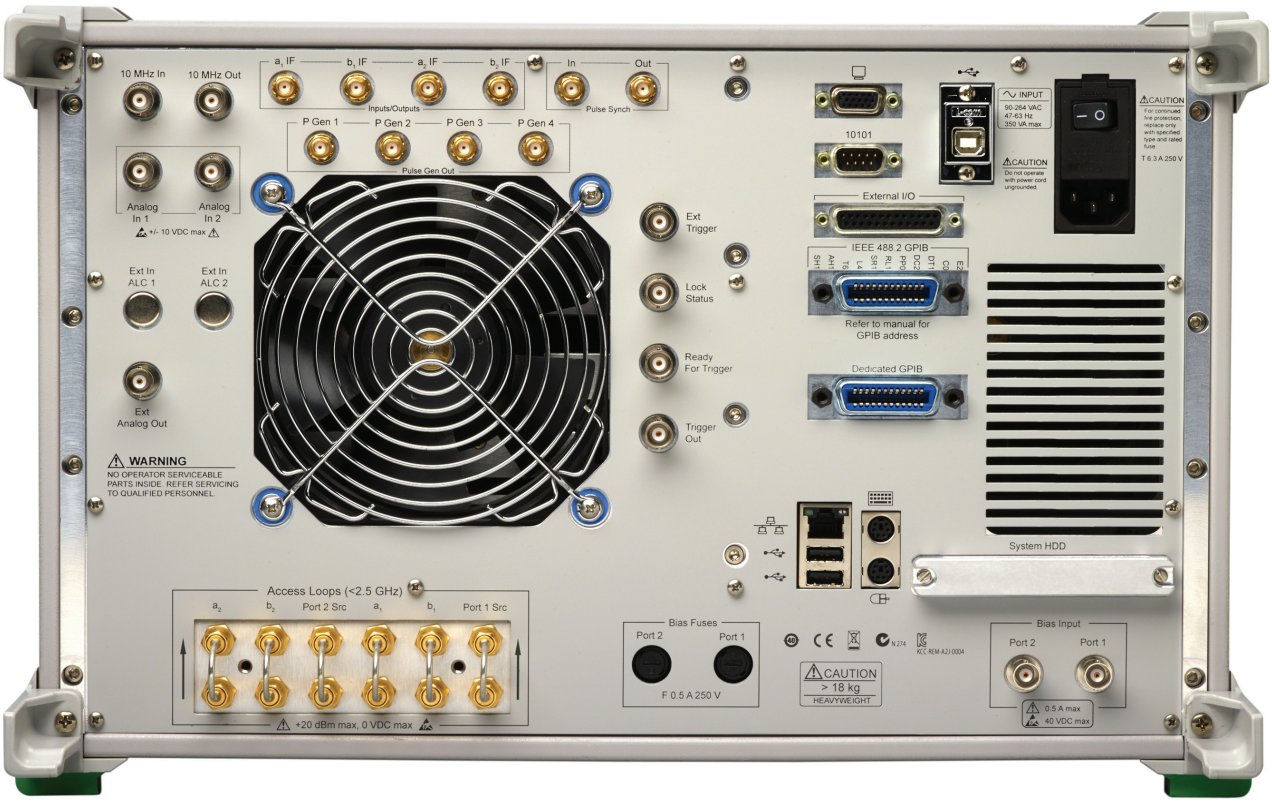
Chassis Grounding Port

Banana (female)

Ports to Millimeter-Wave Test Set (optional)

Connector Type	K (female) (LO1, and LO2 for RF; One with single source; Two with Option 031 Dual Source)

Rear Panel Connections



MS4640B Series Rear Panel (with Option 035)

AC Power Input	AC Input connector, with On/Off switch, and fuses 350 VA maximum, 90 to 264 VAC, 47 to 63 Hz (power factor controlled)
USB, PS/2, and LAN	
USB Control Port	Type B USB 2.0 port for controlling the instrument externally, for remote operation
USB Ports	Two Type A USB 2.0 Ports for peripherals such as keyboard, mouse, memory stick, hardware key, etc. (Two more USB ports at the front panel)
Keyboard and Mouse Ports	Dedicated PS/2 ports.
LAN Port	10/100BaseT Ethernet
GPIB Ports	
GPIB Port (Talker/Listener)	Type D-24, female, IEEE 488.2 compatible, for controlling the instrument externally, for remote operation.
GPIB Port (Dedicated Controller)	Type D-24, female, for the control of external instruments such as power meters, external test sets, and similar devices.
External I/O Port	
Type	25-pin D-Sub, female, User-defined I/O for custom external test set interface, to synchronize with different sweep states, such as Start, Stop, Driven Port, and similar parameters.
Pin 1	Limit Pass/Fail
Pins 2, 3, 15, 16	TTL In
Pins 4, 13 14, 21	GND
Pins 5-12, 17-20, 22	TTL Out
Pins 23-25	Reserved
Serial Port	9-pin D-Sub, male, compatible with RS-232, provides control for AutoCal modules and similar devices.
VGA Port	15-pin mini D-Sub, for simultaneously projecting the instrument's screen display onto an external VGA monitor, with 1024 x 768 minimum resolution.
Bias Inputs	
Optional	Requires Active Measurement Suite, Option 061 or 062
Bias Inputs	BNC (female), one per port
Bias Fuses	0.5 A, 250 V, one per port

Direct Access Loops	
Optional	Requires Option 051, 062, or 062
Connector Type	SMA (female)
Description	For Source, Test, and Receive paths, 3 per port, for < 2.5 GHz frequency coverage
Damage Input Levels	+20 dBm maximum, 0 VDC maximum
IF Inputs/Outputs	a_1, a_2, b_1, b_2, IF Inputs/Outputs
Connector Type	SMA (female)
Inputs	Inputs used with external converters such as millimeter-wave modules, or for antenna testing.
Outputs	Outputs used with external IF digitizers and processors.
Nominal Inputs	5 to 200 MHz (mode dependent), 0 dBm for full scale
Nominal Outputs	0.2 to 200 MHz (mode dependent), +10 dBm maximum
10 MHz In	Signal presence is auto-sensing (better than 1000 ppm frequency accuracy is recommended).
Connector Type	BNC (female)
Signal	–10 dBm to +3 dBm, 50 Ω Nominal
10 MHz Out	Derived from the internal reference, unless an external 10 MHz reference input is applied.
Connector Type	BNC (female)
Signal	0 ± 5 dBm sinusoidal, 50 Ω Nominal
Analog In 1 and 2	Two independent inputs for measurements simultaneous with the RF measurements, for current sensing, efficiency computation, power detection, and similar parameters.
Connector Type	BNC (female)
Range	–10 V to +10 V with automatic offset and gain calibrations
Accuracy	2 mV + 2 % for |V| < 5 V; 2 % for |V| > 5 V
Nominal Input Impedance	60 kΩ
Ext In ALC 1 and ALC 2	For external automatic level control of the internal signal source generators.
Optional	ALC 1 is available with Options 080/081, 082/083, 086/087. ALC 1 and ALC 2 are both available with Options 031 and 084/085, 088/089.
Connector Type	BNC (female)
Ext Analog Out	For external attenuator control, external switch control, analog triggering assistance, measurement system integration, and other purposes.
Connector Type	BNC (female)
Normal Operating Modes	Sawtooth synch sweep, TTL indication of driving port, open loop level controller
Range	–10 V to +10 V; low impedance drive
Accuracy	20 mV + 2 % (Load: > 5 kΩ)
Ext Trigger	
Connector Type	BNC (female)
Voltage Input	0 to 3.3 V input (5 V tolerant)
Impedance	High impedance (> 100 kΩ)
Pulse Width	100 ns minimum input pulse width
Edge Trigger	Programmable edge trigger
Lock Status	
Connector Type	BNC (female)
Voltage Input	0 to 3.3 V input (5 V tolerant)
Impedance	High impedance (> 100 kΩ)
Pulse Width	100 ns minimum input pulse width
Edge Trigger	Positive-edge trigger
Ready for Trigger	
Connector Type	BNC (female)
Voltage Input	0 to 3.3 V latched output
Impedance	Low impedance (approximately 50 Ω)
Voltage	$V_{(output\ high)}$ = 2 V min @ –12 mA $V_{(output\ low)}$ = 0.8 V max @ +12 mA

Trigger Out

Connector Type	BNC (female)
Voltage Output	0 to 3.3 V pulse output 1 µs positive pulse
Voltage	$V_{(output\ high)}$ = 2 V min @ –12 mA $V_{(output\ low)}$ = 0.8 V max @ +12 mA
Impedance	Low impedance (approximately 50 Ω)

Pulse Generator Outputs All values listed are nominal.

Optional	Requires Options 035 and 042 PulseView™
Connector Type	SMA (female)
Pulse Generator Outputs	P GEN 1, P GEN 2, P GEN 3, and P GEN 4
Voltage	High: 3.3 V ± 10 % Low: < 1 V
Drive Impedance	Low impedance (approximately 50 Ω)
Load Impedance	50 Ω or higher impedance

Pulse Synch Input All values listed are nominal.

Optional	Requires Options 035 and 042 PulseView™
Connector Type	SMA (female)
Voltage Input	High: 3.3 V ± 10 % Low: < 1 V
Signal	5.5 VDC damage level
Latency	55 ns delay from received synch to T_0 (typical)
Impedance	High impedance input

Pulse Synch Output All values listed are nominal.

Optional	Requires Options 035 and 042 PulseView™
Connector Type	SMA (female)
Voltage Output	High: 3.3 V ± 10 % Low: < 1 V
Signal	5.5 VDC damage level
Latency	< 5 ns delay from T_0 to providing an external synch (typical)
Drive Impedance	Low impedance (approximately 50 Ω)
Load Impedance	50 Ω or higher impedance

Mechanical and Environmental

Dimensions Dimensions listed are for the instrument without rack mount option (MS4640B-001) attached.

Height	267 mm body (6U) 286 mm between feet outer edges
Width	426 mm body 457 mm between feet outer edges 487 mm between front panel handle outer edges
Depth	502 mm body 591 mm between handle and foot outer edges

Weight < 30 kg (< 66 lb), Typical weight for a fully-loaded MS4647B VNA

Environmental – Operating

Specification	Conforms to MIL-PRF-28800F (class 3)
Temperature Range	0 °C to +50 °C without error codes Except for 'unleveled' error messages that may occur at the extreme edges of the temperature range.
Relative Humidity	5 % to 95 % at +40 °C, Non-condensing
Altitude	4,600 m (15,000 ft)

Environmental – Non-Operating

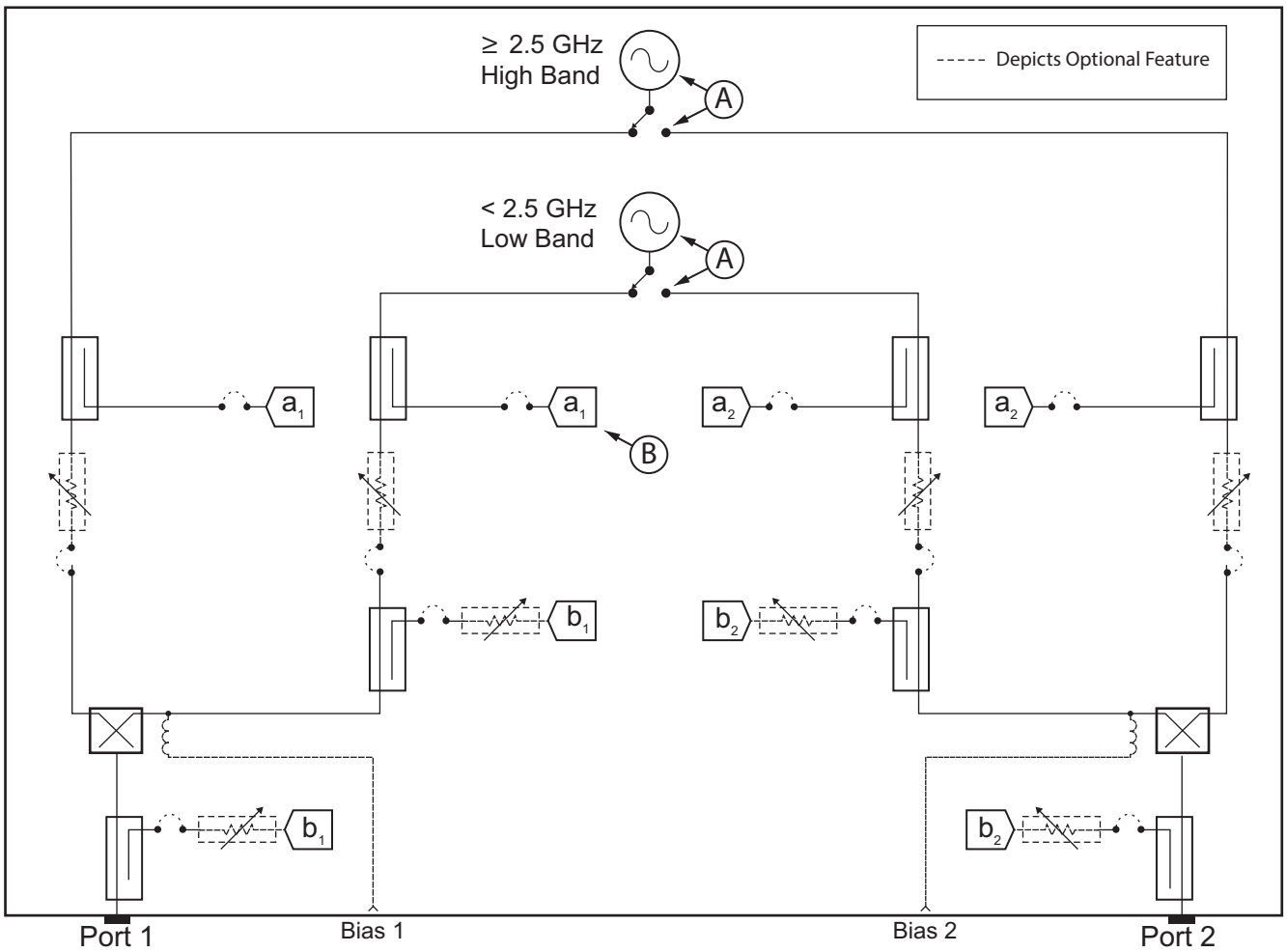
Temperature Range	–40 °C to +75 °C
Relative Humidity	0 % to 90 % at +65 °C, Non-condensing
Altitude	15,200 m (49,000 ft)

EMI	Conforms to and meets the requirements of:
EMC Directive	2004/108/EC
Low Voltage Directive	2006/95/EC
Emissions	EN55011:2009+A1:2010 Group 1 Class A
Immunity	EN 61000-4-2-2009, 4 kV CD, 8 kV AD EN 61000-4-3:2006+A2:2010, 3 V/m EN 61000-4-4:2004, 0.5 kV S-L, 1 kV P-L EN 61000-4-5:2006, 0.5 kV S-L, 1 kV L-E EN 61000-4-6:2009, 3 V EN 61000-4-11:2004, 100 % @ 20 ms

Warranty

Instrument and Built-In Options	3 years from the date of shipment (standard warranty)
Calibration Kits	Typically 1 year from the date of shipment
Test Port Cables	Typically 1 year from the date of shipment
Additional Warranty Options	Additional warranty available

Block Diagram



MS4640B Series VNA Block Diagram – Fully Loaded Configuration

A. With Option 031 Dual Source Architecture, second low-band and high-band sources are added and the two switches are removed. One set of sources is dedicated to each of the VNA test port paths.

B. With Option 035 IF Digitizer, high speed digitizers are added to the receiver paths (a_1, b_1, a_2, b_2) for fast IF detection.

C. With Option 032, Internal RF Combiner (requires option 031 Dual Source Architecture) a switch is added that can redirect the source 2 drive signal over to a coupler embedded in the source 1 path. Option 032 adds a switch in the source 2 path after the source attenuator (before the source loop. The switch output is connected to a coupler at the input to the Port 1 test coupler. Thus two tones (one from source 1 and one from source 2) can be delivered to port 1.

36585-Series Automatic Calibrators (AutoCal)

The 36585-Series Precision Automatic Calibrator (AutoCal) Module provides industry-leading performance in corrected characteristics using over-determined algorithms, and transferring characteristics from a highly accurate LRL type calibration. The resulting accuracies will even out perform a Sliding Load SOLT calibration. In order to remove the effects of matched adapters, the Precision 36585-Series AutoCal comes in a variety of connector gender types (m-m, f-f, and m-f). Adapter Removal Calibration routine is still available in the VectorStar software. With coverage from 70 kHz to 70 GHz, the 36585-series Precision AutoCal offers not only the fastest and most reliable calibration, but also the most accurate broadband coaxial VNA calibration method.

36585V Series Precision AutoCal Module

36585 Series Precision AutoCal Calibration Kit

Description	Additional Information	Part Number
Precision AutoCal, K 70 kHz to 40 GHz, 2-port	K (male) to K (male)	36585K-2M
	K (female) to K (female)	36585K-2F
	K (male) to K (female)	36585K-2MF
Precision AutoCal, V 70 kHz to 70 GHz, 2-port	V (male) to V (male)	36585V-2M
	V (female) to V (female)	36585V-2F
	V (male) to V (female)	36585V-2MF

AutoCal General and Environmental

36581-Series Dimensions	65 mm H x 155 mm W x 90 mm D body (excluding connectors)
36585-Series Dimensions	42 mm H x 64 mm W x 140 mm D body (excluding connectors)
Control	Serial RS-232 control by the VNA via supplied 9-pin D-Sub cable (allowing forward-compatibility to legacy AutoCAL)
Power	DC powered via supplied universal 110/220 V AC/DC adapter (with enough power to maintain optimum stability)
Operating Temperature	18 to 28 °C
Storage Temperature	–20 to 70 °C
Relative Humidity	5 % to 95 % at 40 °C, Non-condensing
EMI	Conforms to and meets the requirements of:
EMC Directive	2004/108/EC
Low Voltage Directive	2006/95/EC
Emissions	EN55011:2009+A1:2010 Group 1 Class A
Immunity	EN 61000-4-2-2009, 4 kV CD, 8 kV AD EN 61000-4-3:2006+A2:2010, 3 V/m EN 61000-4-4:2004, 0.5 kV S-L, 1 kV P-L EN 61000-4-5:2006, 0.5 kV S-L, 1 kV L-E EN 61000-4-6:2009, 3 V EN 61000-4-11:2004, 100 % @ 20 ms

Mechanical Calibration Kits

SMA/3.5 mm Calibration Kit, 3650A Series

3650A cal kit provides 50 Ω calibrations for 3.5 mm or SMA devices using 3.5 mm standards. 3650A-1 cal kit includes Sliding Loads.

3650A Cal Kit contains:	Additional Information (typical)	Quantity	Part Number
Termination 3.5 mm (male)	Return Loss: > 37 dB (F ≤ 18.5 GHz) > 30 dB (F > 18.5 GHz)	2	28S50-2
Termination 3.5 mm (female)		2	28SF50-2
Open 3.5 mm (male)	Offset: 5 mm	1	24S50
Open 3.5 mm (female)	Offset: 5 mm	1	24SF50
Short 3.5 mm (male)	Offset: 5 mm	1	23S50
Short 3.5 mm (female)	Offset: 5 mm	1	23SF50
Adapter, 3.5 mm (male) to 3.5 mm (male)		1	33SS50
Adapter, 3.5 mm (female) to 3.5 mm (female)		2	33SFSF50
Adapter, 3.5 mm (male) to 3.5 mm (female)		2	33SSF50
Torque Wrench	5/16 in, 0.9 N·m (8 lbf·in)	1	01-201
Wrench, Universal	For SMA, 3.5 mm, 2.4 mm, K and V Connectors	1	01-204
Pin Depth Gauge		1	01-222
Adapter (female) for Pin Gauge		1	01-223
Reference Flat		1	01-210
Connector Thumb Wheel		4	A18311
Coefficients for standards	Provided on a memory device and 3.5 in floppy disk	1	–
3650A-1 Cal Kit adds:	**Additional Information (typical)**	**Quantity**	**Part Number**
Sliding Termination 3.5 mm (male)		1	17S50
Sliding Termination 3.5 mm (female)		1	17SF50
Flush Short (male)		1	01-211
Flush Short (female)		1	01-212

K (2.92 mm) Calibration Kit, 3652A Series

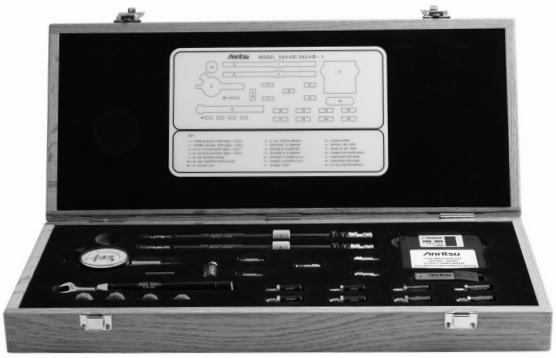
3652A cal kit provides 50 Ω calibrations for K devices. 3652A-1 cal kit includes Sliding Loads.

3652A Cal Kit contains:	Additional Information (typical)	Quantity	Part Number
Termination K (male)	Return Loss: > 34 dB (F ≤ 18.5 GHz) > 32 dB (F ≤ 40 GHz)	2	28K50A
Termination K (female)		2	28KF50A
Open K (male)	Offset: 5 mm	1	24K50
Open K (female)	Offset: 5 mm	1	24KF50
Short K (male)	Offset: 5 mm	1	23K50
Short K (female)	Offset: 5 mm	1	23KF50
Adapter, K (male) to K (male)		1	33KK50B
Adapter, K (female) to K (female)		2	33KFKF50B
Adapter, K (male) to K (female)		2	33KKF50B
Torque Wrench	5/16 in, 0.9 N·m (8 lbf·in)	1	01-201
Wrench, Universal	For SMA, 3.5 mm, 2.4 mm, K, and V Connectors	1	01-204
Pin Depth Gauge		1	01-222
Adapter (female) for Pin Gauge		1	01-223
Reference Flat		1	01-210
Connector Thumb Wheel		4	A18311
Coefficients for standards	Provided on a USB memory device and 3.5 in floppy disk	1	-
3652A-1 Cal Kit adds:		**Quantity**	**Part Number**
Sliding Termination K (male)		1	17K50
Sliding Termination K (female)		1	17KF50
Flush Short (male)		1	01-211
Flush Short (female)		1	01-212

V (1.85 mm) Calibration Kit, 3654D Series

3654D cal kit provides 50 Ω calibrations for V devices. 3654D-1 cal kit includes Sliding Loads.

3654D Cal Kit contains:	Additional Information (typical)	Quantity	Part Number
Termination V (male)	Return Loss: > 40 dB (F ≤ 20 GHz); > 35 dB (F ≤ 40 GHz) > 32 dB (F ≤ 67 GHz); > 28 dB (F ≤ 70 GHz)	2	28V50D
Termination V (female)		2	28VF50D
Open V (male)	Offset: 4.75 mm	1	24V50C
Open V (female)	Offset: 4.75 mm	1	24VF50C
Short V (male)	Offset: 5.1 mm	1	23V50C
Short V (female)	Offset: 5.1 mm	1	23VF50C
Adapter, V (male) to V (male)		1	33VV50C
Adapter, V (female) to V (female)		2	33VFVF50C
Adapter, V (male) to V (female)		2	33VVF50C
Male Adapter	GPC-7 to 3.5 mm	2	34AS50-2
Female Adapter	GPC-7 to 3.5 mm	2	34ASF50-2
Torque Wrench	5/16 in, 0.9 N·m (8 lbf·in)	1	01-201
Wrench, Universal	For SMA, 3.5 mm, 2.4 mm, K, and V Connectors	1	01-204
Reference Flat		1	01-210
Pin Depth Gauge		1	01-322
Adapter (female) for Pin Gauge		1	01-323
Connector Thumb Wheel		4	A18311
Coefficients for standards	Provided on a USB memory device and 3.5 in floppy disk	1	–
3654D-1 Cal Kit adds:	**Additional Information (typical)**	**Quantity**	**Part Number**
Sliding Termination V (male)		1	17V50C
Sliding Termination V (female)		1	17VF50C
Flush Short (male)		1	01-312
Flush Short (female)		1	01-311



3654D Series, V (1.85 mm) Calibration Kit

V (1.85 mm) Multi-Line Calibration Kit, 3657 Series

The 3657 Calibration Kit provides 50 Ω beadless V (male to male) lines for metrology applications. The 3657-1 Calibration Kit includes Shorts for LRL-type coaxial calibrations.

3657 Cal Kit contains:	Additional Information (typical)		Quantity	Part Number
Line 1	Electrical Length = 15 mm; 50 Ω	Center Conductor	1	65899-1
		Outer Conductor	1	65898-1
Line 2	Electrical Length = 16.7 mm; 50 Ω	Center Conductor	1	65899-2
		Outer Conductor	1	65898-2
Line 3	Electrical Length = 18.4 mm; 50 Ω	Center Conductor	1	65899-3
		Outer Conductor	1	65898-3
Line 4	Electrical Length = 20.1 mm; 50 Ω	Center Conductor	1	65899-4
		Outer Conductor	1	65898-4
Line 5	Electrical Length = 21.8 mm; 50 Ω	Center Conductor	1	65899-5
		Outer Conductor	1	65898-5
Line 6	Electrical Length = 49.84 mm; 50 Ω	Center Conductor	1	65899-6
		Outer Conductor	1	65898-6
Tool, Center Conductor Removal Plug			1	65922
Fixture, Center Conductor Installation, Short	For Lines 1 to 5		1	65901-1
Fixture, Center Conductor Installation, Long	For Line 6		1	65901-6
Open-Ended Wrench	7 mm		1	783-1243
Torque Wrench	5/16 in, 0.9 N·m (8 lbf·in)		1	01-201
3657-1 Cal Kit adds:	**Additional Information (typical)**		**Quantity**	**Part Number**
Short V (male)	Offset: 5.1 mm		2	23V50B
Short V (female)	Offset: 5.1 mm		2	23VF50B

3657 Series, V (1.85 mm) Multi-Line Calibration Kit

Verification Kits

Verification kits include characterized traceable standards (two attenuators, an airline, and a stepped impedance airline Beatty Standard) that can be used with the provided Performance Verification Software (PVS) and data to verify the calibration and resulting performance of your VNA.

The applicable calibrations are Short-Open-Load-Through (SOLT) with and without Sliding Loads for the 3666-1, 3668-1, and 3669B-1 Verification Kits. The verification kits are used with the 365x and 365x-1 Cal Kits, and 36585x Series AutoCal, male-female version. Cal Kits and AutoCal are purchased separately. These verification kits are dedicated for the MS4640B Series VNAs, and are not for older VNAs.

Verification is also provided as a service, eliminating the investment in kits.

VectorStar MS4640B VNA Verification Kits

3666-1	SMA/3.5 mm Connector Verification Kit
3668-1	K Connector Verification Kit
3669B-1	V Connector Verification Kit

366X-X Verification Kit

Precision Adapters, Attenuators, and More

Precision Adapters, Attenuators, and Other Components

Anritsu carries a complete line of precision adapters and attenuators. For more information, please visit our web site at www.anritsu.com.

Test Port Cables

3670-Series Test Port Cables, Ruggedized Semi-Rigid, up to 70 GHz

Description	Frequency Range	Nominal Impedance	Insertion Loss (dB, typical)	Return Loss (dB, typical)	Length	Part Number
K (female) to K (male)	DC to 40 GHz	50 Ω	2.3 dB/m @ 20 GHz 4.7 dB/m @ 40 GHz	≥ 16	30.5 cm (12 in)	3670K50-1
					61.0 cm (24 in)	3670K50-2
V (female) to V (male)	DC to 70 GHz	50 Ω	3.6 dB/m @ 20 GHz 5.2 dB/m @ 40 GHz 7.2 dB/m @ 70 GHz	≥ 16	30.5 cm (12 in)	3670V50A-1
					61.0 cm (24 in)	3670V50A-2

70 GHz Phase Stable Flexible Test Port Cables, 3671-Series

70 GHz Ruggedized Semi-Rigid Test Cables, 3670-Series

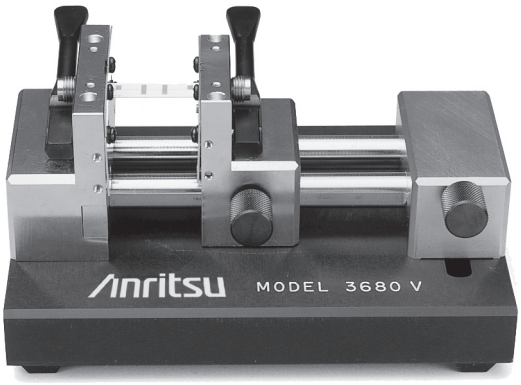
3671-Series Test Port Cables, Flexible, Phase Stable, up to 70 GHz

Description	Frequency Range	Nominal Impedance	Insertion Loss (dB, f in GHz)	Return Loss (dB)	Phase Stability (± degrees, f in GHz)	Length	Part Number
K (female) to 3.5 mm (male)	DC to 26.5 GHz	50 Ω	0.11 + 0.01f + 0.30 √f	≥ 18	≤ (0.5 + 0.13f) (1 coil)	60 cm (23.5 in)	3671KFS50-60
K (female) to K (male or female)	DC to 40 GHz	50 Ω	0.26 + 0.006f + 0.46 √f	≥ 16	(0.5 + 0.08f) (1/2 coil)	60 cm (23.5 in)	3671KFK50-60
K (female) to K (male)	DC to 40 GHz	50 Ω	0.39 + 0.013f + 0.64 √f	≥ 16	≤ (0.5 + 0.17f) (1 coil)	100 cm (39.3 in)	3671KFK50-100
K (female) to K (female)	DC to 40 GHz	50 Ω	0.26 + 0.006f + 0.46 √f	≥ 16	(0.5 + 0.08f) (1/2 coil)	60 cm (23.5 in)	3671KFKF50-60
V (female) to V (male)	DC to 70 GHz	50 Ω	≤ 6.0 @ 70 GHz	≥ 14	≤ 8.5 (1/2 coil)	60 cm (23.5 in)	3671VFV50-60
V (female) to V (male)	DC to 70 GHz	50 Ω	≤ 9.3 @ 70 GHz	≥ 14	≤ 10.5 (1 coil)	100 cm (39.3 in)	3671VF50-100

Universal Test Fixture (UTF)

The 3680-series UTF provide an accurate, repeatable solution for measuring microstrip and coplanar substrate devices.

- Input and output connections are made to the substrate device by two spring-loaded jaws that include coax-to-microstrip/coplanar launchers.
- One jaw is movable in two dimensions to accommodate substrates of different lengths and offsets.
- Right angle launchers are available for right angle devices.
- Microstrip calibration/verification kits are available for substrate thicknesses of 10 mil (60 GHz), 15 mil (30 GHz), and 25 mil (20 GHz).
- A coplanar waveguide calibration/verification kit is also available.



3680 Series Universal Test Fixture (UTF)

UTF Electrical Specifications

Type	Frequency Range (GHz)	Return Loss (dB)	Repeatability (dB)	Frequency Coverage	Part Number
UTF	DC to 20	> 17	< 0.10	DC to 20 GHz	3680-20
	20 to 40	> 14	< 0.20	DC to 40 GHz	3680K
	40 to 60	> 8	< 0.30	DC to 60 GHz	3680V
Right Angle Launcher	DC to 20	> 16	< 0.15	DC to 40 GHz	36801K
	20 to 40	> 12	< 0.25	DC to 60 GHz	36801V
	40 to 60	> 7	< 0.40		

UTF General Information

Substrate Length	3680-20, 0.5 cm (min) to 10 cm (max) 3680K, 0.5 cm (min) to 5 cm (max) 3680V, 0.5 cm (min) to 5 cm (max)
Maximum Substrate Width	All UTF models, No Limit
Substrate Thickness	All UTF models, 0.12 mm (min), 1.9 mm (max)
Maximum Line Offset	3680-20, ± 2.5 cm 3680K, ± 1.2 cm 3680V, ± 1.2 cm
Input and Output Connectors	3680-20, 3.5 mm (females) 3680K, K (females) 3680V, V (females)
Overall Size	All UTF models, 10 cm x 12.7 cm x 6.4 cm

UTF Right Angle Launcher

Distance from in-line connector, axial	All UTF models, 1 cm (min), 4 cm (max)
Distance from in-line connector, offset	All UTF models, 0 cm (min), 2 cm (max)

Ordering Information

Instrument Models	The VectorStar MS4640B Series VNAs are available in four models to meet different frequency range requirements. Refer to "Standard Capabilities" on page 2-30 for extended operational frequency ranges.
MS4642B	Vector Network Analyzer 10 MHz to 20 GHz
MS4644B	Vector Network Analyzer 10 MHz to 40 GHz
MS4645B	Vector Network Analyzer 10 MHz to 50 GHz
MS4647B	Vector Network Analyzer 10 MHz to 70 GHz
Included Accessories	Each VNA comes with a set of included accessories.
User Documentation USB	The user documentation USB includes PDF files for the VectorStar Operation Manual, User Interface Reference Manual, Programming Manual, Programming Manual Supplement, Calibration and Measurement Guide, Technical Data Sheet and Configuration Guide, and Maintenance Manual.
Online Help	The instrument is equipped with context-sensitive help built from the first five documents above.
Peripherals	Optical USB Mouse
Power	Power Cord
Main VNA Options	
MS4640B-001	Rack Mount, adds handles and removes feet for shelf-mounting into a 19" universal rack
MS4640B-002	Time Domain
MS4640B-004	Additional Serial-ATA (SATA) Solid State Drive (SSD) with OS and VectorStar Application Software
MS4640B-007	Receiver Offset
MS464xB-031	Dual Source Architecture
MS464xB-032	Internal RF Combiner, requires Option 031
MS4640B-035	IF Digitizer
MS4640B-041	Noise Figure, requires Option 051, 061, or 062
MS4640B-042	PulseView™, requires Option 035
MS4640B-043	DifferentialView™
MS4640B-044	IMDView™
MS464xB-051	Direct Access Loops, see description below
MS464xB-061/062	Active Measurement Suite options, see description below
MS4640B-070	70 kHz Low-End Frequency Extension
Direct Access Loop Options	**Note:** Direct access loops are not available for VNAs equipped with Options 061 or 062, which include loops.
MS4642B-051	Direct Access Loops for MS4642B, not available with Options 061 or 062
MS4644B-051	Direct Access Loops for MS4644B, not available with Options 061 or 062
MS4645B-051	Direct Access Loops for MS4645B, not available with Options 061 or 062
MS4647B-051	Direct Access Loops for MS4647B, not available with Options 061 or 062
Active Measurement Suite Options	
MS4642B-061	Active Measurements Suite, For MS4642B, with 2 Step Attenuators
MS4642B-062	Active Measurements Suite, For MS4642B, with 4 Step Attenuators
MS4644B-061	Active Measurements Suite, For MS4644B, with 2 Step Attenuators
MS4644B-062	Active Measurements Suite, For MS4644B, with 4 Step Attenuators
MS4645B-061	Active Measurements Suite, For MS4645B, with 2 Step Attenuators
MS4645B-062	Active Measurements Suite, For MS4645B, with 4 Step Attenuators
MS4647B-061	Active Measurements Suite, For MS4647B, with 2 Step Attenuators
MS4647B-062	Active Measurements Suite, For MS4647B, with 4 Step Attenuators
Pulse Modulator Test Sets	
SM6628	Pulse Modulator Test Set, 70 kHz to 40 GHz, for source modulation with an MS4642B or MS4644B
SM6629	Pulse Modulator Test Set, 70 kHz to 40 GHz, for source and receiver modulation with an MS4642B or MS4644B
SM6630	Pulse Modulator Test Set, 70 kHz to 70 GHz, for source modulation with an MS4645B or MS4647B
SM6631	Pulse Modulator Test Set, 70 kHz to 70 GHz, for source and receiver modulation with an MS4645B or MS4647B
Multiport VNA Options	The multiport VNA option provides four test ports for all VectorStar MS4640B Series VNAs with the MN469xC Series Multiport Test Sets. The option provides the Test Set, necessary cabling, and installation documentation. The Test Set frequency range is limited to that of the attached VNA.
MN4694C	70 kHz to 40 GHz, Use the MN4694C Test Set with MS4642B and MS4644B VNAs
MN4697C	70 kHz to 70 GHz, Use the MN4697C Test Set with MS4645B and MS4647B VNAs
Documentation	For detailed MN469xC specifications, refer to the VectorStar MN469xC Series Multiport VNA Technical Data Sheet – 11410-00777

Broadband/Banded/Millimeter-Wave Systems For details on the MS464xB-08x series of options, see the:

VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593
VectorStar ME7838D Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00778
VectorStar ME7838E Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00767

Calibration Options

MS4640B-098	Z540/Guide 25 Calibration, No Data
MS4640B-099	Premium Calibration, With Data

Precision Automatic Calibrator Modules (Precision AutoCal)

36585K-2M	K Precision AutoCal Module, 70 kHz to 40 GHz, K (male) to K (male)
36585K-2F	K Precision AutoCal Module, 70 kHz to 40 GHz, K (female) to K (female)
36585K-2MF	K Precision AutoCal Module, 70 kHz to 40 GHz, K (male) to K (female)
36585V-2M	V Precision AutoCal Module, 70 kHz to 70 GHz, V (male) to V (male)
36585V-2F	V Precision AutoCal Module, 70 kHz to 70 GHz, V (female) to V (female)
36585V-2MF	V Precision AutoCal Module, 70 kHz to 70 GHz, V (male) to V (female)

Mechanical Calibration Kits

3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads
3652A	K Calibration Kit, Without Sliding Loads
3652A-1	K Calibration Kit, With Sliding Loads
3654D	V Calibration Kit, Without Sliding Loads
3654D-1	V Calibration Kit, With Sliding Loads
3657	V Multi-Line Calibration Kit, Without Shorts
3657-1	V Multi-Line Calibration Kit, With Shorts

Verification Kits

3666-1	SMA/3.5 mm Verification Kit
3668-1	K Verification Kit
3669B-1	V Verification Kit

Test Port Cables, Ruggedized Semi-Rigid

3670K50-1	Test Port Cable, K (female) to K (male), 1 each, 30.5 cm (12 in)
3670K50-2	Test Port Cable, K (female) to K (male), 1 each, 61.0 cm (24 in)
3670V50A-1	Test Port Cable, V (female) to V (male), 1 each, 30.5 cm (12 in), rated to 70 GHz
3670V50A-2	Test Port Cable, V (female) to V (male), 1 each, 61.0 cm (24 in), rated to 70 GHz

Test Port Cables, Flexible, Ruggedized-Style Female Connectors, Phase Stable

Ruggedized style female connectors for VNA test ports.

3671KFS50-60	K (female) to 3.5 mm (male), 2 each 63.5 cm (25 in)
3671KFK50-60	K (female) to K (male), 1 each, 63.5 cm (25 in)
3671KFK50-100	K (female) to K (male), 1 each, 96.5 cm (38 in)
3671KFKF50-60	K (female) to K (female), 1 each 63.5 cm (25 in)
3671VFV50-60	V (female) to V (male), 2 each, 63.5 cm (25 in), rated to 67 GHz
3671VFV50-100	V (female) to V (male), 1 each 96.5 cm (38 in), rated to 67 GHz

Test Port Converters To change or replace VNA test ports.

34YK50C	Universal Test Port Connector to K (male), Installation requires wrench 01-202 (not included)
34YV50C	Universal Test Port Connector to V (male), Installation requires wrench 01-202 (not included)
34YS50A	Universal Test Port Connector to 3.5 mm (male), Installation requires wrench 01-202 (not included)
34YQ50A	Universal Test Port Connector to 2.4 mm (male), Installation requires wrench 01-202 (not included)

Universal Test Fixture (UTF)

3680-20	UTF, DC to 20 GHz
3680K	UTF, DC to 40 GHz
3680V	UTF, DC to 60 GHz
36801K	UTF Right Angle Launcher, DC to 30 GHz
36801V	UTF Right Angle Launcher, DC to 50 GHz
36803	Bias Probe
36804B-10M	Microstrip Calibration/Verification Kit, 10 mil, DC to 50 GHz
36804B-15M	Microstrip Calibration/Verification Kit, 15 mil, DC to 30 GHz
36804B-25M	Microstrip Calibration/Verification Kit, 25 mil, DC to 15 GHz

Precision Fixed Attenuators, Adapters (in and out of series, waveguide to coaxial), and more

Refer to our extensive Precision RF & Microwave Components Catalog – 11410-00235

GPIB Cables

2100-5	GPIB Cable, 0.5 m long
2100-1	GPIB Cable, 1 m long
2100-2	GPIB Cable, 2 m long
2100-4	GPIB Cable, 4 m long

Transit Case

760-246-R	Transit Case, for all MS4640B Series VNAs, Hard plastic with wheels, 85 cm x 70 cm x 45 cm

Tools

01-201	Torque End Wrench, 5/16 in, 0.9 N·m (8 lbf·in), For tightening male devices, For SMA, 3.5 mm, 2.4 mm, K, and V connectors.
01-202	Torque End Wrench, 1/2 in, 60 lbf ·in, For servicing the universal test port, For the removal or installation of a test port.
01-203	Torque End Wrench, 20.6 mm (13/16 in), 0.9 N·m (8 lbf·in), For tightening the VNA test ports to female devices.
01-204	End Wrench, 5/16 in, Universal, Circular, Open-ended, For SMA, 3.5 mm, 2.4 mm, K and V connectors.
01-504	Torque End Wrench, 6 mm, 0.45 N·m (4 lbf·in), For tightening 1 mm connectors.
01-505	6 mm × 7 mm Open End Wrench, Backing wrench for 6 mm torque wrench above for W1 connectors.
01-511	Torque End Wrench, 4 mm (5/32 in), 0.22 N·m (2 lbf·in), For tightening the SSMC TEST and REF connectors on 3743A Modules.

Documentation

User Documentation Disc	Soft copies of the manuals as Adobe PDF files are included on the User Documentation CD that is provided with the instrument. The Maintenance Manual PDF is available from Anritsu Customer Service. All other manuals available as free downloads at www.anritsu.com. Printed manuals in 3-ring binders are available for a nominal charge.
10410-00317	MS4640B Series VNA Operation Manual (OM)
10410-00318	MS4640B Series VNA Calibration and Measurement Guide (MG)
10410-00319	MS4640B Series VNA User Interface Reference Manual (UIRM)
10410-00320	MS4640B Series VNA Maintenance Manual (MM)
10410-00322	MS4640B Series VNA Programming Manual (PM), for IEEE 488.2, System, and SCPI Commands
10410-00323	MS4640B Series VNA Programming Manual Supplement (PMS), for Lightning 37xxxx and HP8510 Emulation

Extended Service Options

Use the table below to select the service location, service period, type of service, and the VectorStar instrument model number.

Service Location	Service Period	Type of Service	VNA Model	Part Number
On-Site	3 Years	Repair Only	MS4642B	MS4642B-ES311
			MS4644B	MS4644B-ES311
			MS4645B	MS4645B-ES311
			MS4647B	MS4647B-ES311
On-Site	3 Years	Standard Calibration	MS4642B	MS4642B-ES314
			MS4644B	MS4644B-ES314
			MS4645B	MS4645B-ES314
			MS4647B	MS4647B-ES314
On-Site	3 Years	Premium Calibration	MS4642B	MS4642B-ES318
			MS4644B	MS4644B-ES318
			MS4645B	MS4645B-ES318
			MS4647B	MS4647B-ES318
Service Center	3 Years	Standard Calibration	MS4642B	MS4642B-ES312
			MS4644B	MS4644B-ES312
			MS4645B	MS4645B-ES312
			MS4647B	MS4647B-ES312
Service Center	3 Years	Premium Calibration	MS4642B	MS4642B-ES315
			MS4644B	MS4644B-ES315
			MS4645B	MS4645B-ES315
			MS4647B	MS4647B-ES315

Service Center	5 Years	Repair Only	MS4642B	MS4642B-ES510
			MS4644B	MS4644B-ES510
			MS4645B	MS4645B-ES510
			MS4647B	MS4647B-ES510
Service Center	5 Years	Standard Calibration	MS4642B	MS4642B-ES512
			MS4644B	MS4644B-ES512
			MS4645B	MS4645B-ES512
			MS4647B	MS4647B-ES512
Service Center	5 Years	Premium Calibration	MS4642B	MS4642B-ES515
			MS4644B	MS4644B-ES515
			MS4645B	MS4645B-ES515
			MS4647B	MS4647B-ES515
Service Center	5 Years	Repair and Standard Calibration	MS4642B	MS4642B-ES513
			MS4644B	MS4644B-ES513
			MS4645B	MS4645B-ES513
			MS4647B	MS4647B-ES513
Service Center	5 Years	Repair and Premium Calibration	MS4642B	MS4642B-ES516
			MS4644B	MS4644B-ES516
			MS4645B	MS4645B-ES516
			MS4647B	MS4647B-ES516

Post-Delivery Upgrade Options

If your needs change, it’s reassuring to know that your Anritsu product can grow with you. Contact your local Anritsu service center for adding internal options or increasing the frequency coverage of your existing MS4640B Series VNA.

Notes

VectorStar®

Find Drivers, Utilities, Software Updates, and other Helpful Tools at the VectorStar Users Site. Visit:
www.anritsu.com/en-us/Products-Solutions/Solution/Welcome-to-the-VectorStar-Users-Site-.aspx

Training at Anritsu

Anritsu has designed courses to help you stay up to date with technologies important to your job. For available training courses visit:
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List Revision Date: 20141016

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